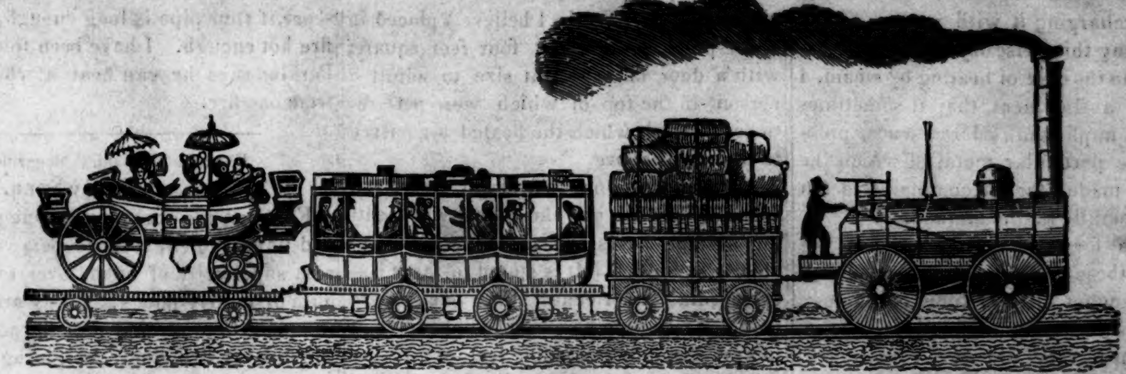

AMERICAN RAILROAD JOURNAL,

AND ADVOCATE OF INTERNAL IMPROVEMENTS.

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AMERICAN RAILROAD JOURNAL.

NEW-YORK, JUNE 18, 1836.

We give in this Number, a part of the Appendix to Pambour on Locomotion; it will be concluded in the next number.

From the Mechanics' Magazine.

The following Questions, which were proposed in a late number of the Mechanics' Magazine, are, in consequence of some mistakes then made in them, again offered for consideration, with some modifications and additions.

QUESTIONS RESPECTING WATER-WHEELS, AND HEATING AND VENTILATING DWELLING HOUSES, OR OTHER BUILDINGS.

Can a stream of water be used to as much advantage, or made to do as much work, upon a horizontal wheel as upon a vertical one; and if so, what is the best construction for one, and what the cost of building it?

Can the same quantity of water that is let, in a thin sheet, upon a vertical wheel, (that is a wheel upon a horizontal shaft,) be made, in any way, to produce the same effect, when let in solid column upon a horizontal wheel, on a vertical shaft?

What have been the results of the experiments upon water wheels, made under the direction of the Franklin Institute, at Philadelphia? What kind of wheel was found best adapted to, or most effective under any given head and fall?

What is the best and most economical mode of heating dwelling-houses, schools, and lecture rooms, factories or other large buildings? By introducing heated air from a furnace—by pipes, heated by steam, carried around the sides of each room, or by similar pipes filled with boiling water?

What is the requisite size of a furnace to heat a room or a house of any given dimensions? What should be the size of the flue, for warm air, for heating the whole house; and what that of the branch flue for each particular room?

What is the best construction for the furnace-pipes, &c. upon the hot air, steam, or hot water plan; and what quantity of fuel (wood or coal) will be consumed per hour, if the fire be kept up, day and night, upon each plan, and what the cost?

What are the requisite dimensions of the furnace, boiler, pipes, &c. to be properly proportioned to the size of the whole building and to each room; and what the whole cost?

Are pipes of hot water, which are used to such advantage in England, sufficient for the purpose in a country where the winters are so intensely cold as ours sometimes are?

D*** F*****.

The following communication is in reply to some queries published in a late number, and now re-published in consequence of several errors in the first publication. The information it furnishes appears to be the result of the observations of a practical man.

We may here remark that some successful observations on heating by steam, are contained in a work, lately received by us, and from which we shall extract much interesting matter on this and other subjects, as soon as we can dispose of the matter already on our hands.

NEW MODES OF HEATING BUILDINGS.

Mr. Minor:—In No. 38, p. 98, of the Magazine, your correspondent D*** F***** inquires what is the best and most economical mode of heating large buildings. As no one more able has replied to this inquiry, in the succeeding numbers, I venture to trouble you with a few casual observations made by me during a few years residence in London; and to request the publication of them, in case you think them likely to be of sufficient use to warrant their appearance in your valuable work.

All the methods I have seen may be divided into two classes,—those in which water intervenes between the fire and the atmosphere,—and those in which the fire is uncovered, or separated from the atmosphere merely by plates of iron. To the second of these there is a well known objection, that the quality of the air is injured by contact with heated iron, in so great a degree as to cause headache and unpleasant sensations in the eyes and even in the skin generally. By some this is said to be owing to a change in the electric state of the air; by others, to the absorption of oxygen by the heated metal:—the remedy they both propose is, to evaporate water; but it has not been shown to my satisfaction, that this entirely removes the evil, or that it does not introduce a dampness that is not always desirable. Besides, this principal objection, there are frequently gases, dust, smoke, and unpleasant odors, arising from stoves and open fires, and particularly from those complicated and expensive rattle-traps, called air-furnaces. From my own observation, and from the verbal reports of many who have used them, and from all that I have read on the subject, it appears that the first class of contrivances are not liable to injure the air, as the others do, by giving it the power of causing headache

&c by surcharging it with vapor, or dust, gases, or any thing else objectionable;—except that in the case of heating by steam, I have read a statement that it sometimes causes an unpleasant odor; owing, probably to the particular metal of which the pipes are made; for the complaint is not applied generally to this method.

So much for the *quality* of the heat obtained by these different methods:—I will now state what little I know of its cost. An obvious advantage of furnaces, stoves, etc., is, that if they are well constructed, you may burn in them almost any kind or quality of fuel, and thereby save the difference between the cheapest and dearest, (supposing, of course, that they are not in your parlors, or exposed to view.) Another advantage is, that you may dispense with the incumbrance of chimnies, and a great deal of expensive ornamental work, amounting, I am told, to a thousand dollars in many houses. But as to the comparative cheapness in respect to fuel of "hot air," "steam," and "hot water," I can only mention a fact reported in the London Journal of Arts and Sciences: that in one case, where hot water was introduced into a house that had previously been heated by hot air, the saving of fuel was one third; but this was not considered a fair test, as the air-furnace had not been well constructed.

At this moment, while I am writing, I have a smoke coming from an air-furnace flue in the corner of my room; by which I am prompted to censure the quackery of the unscientific persons who make these things in such a way that they get filled with dirt, and do not give you a chance to clean them, or remove the oxidised pipe, without pulling down a great quantity of brick-work. The one I have, though economical in respect to fuel, is a nuisance in all other respects, and was still worse before I made a better arrangement of the smoke-pipe, which the stupid constructor had run, after an ascent of two and a half feet, horizontally, for eighteen feet, to its insertion into the kitchen chimney, the large fire-place of which was open immediately under it. Though I consider it for the general good, and therefore for every man's particular interest, to be rather gentle in censuring the well intended blunders of half-ingenious, and wholly unlearned men, yet the number of these nuisances, so expensive at first, and so liable to get out of order, and so difficult to repair, is so rapidly increasing, that I feel bound to give my feeble evidence against all that I have ever seen of them. The fundamental principle on which they are made, is good; but in their construction all simplicity is eschewed, as if complication and multitude of parts were a proof of genius, and not strong presumptive evidence of the want of it. The only arrangement on this principle that I remember to have seen, that is free from the objections just enumerated, was a simple stove, (Dr. Nott's, I believe,) placed in a fire-proof closet about four feet square, with a door of sufficient size to admit a person, in the top of which were perforations, through which the heated air passed to the rooms above.

As to the original cost of hot water and steam apparatus, and the quantity of heating surface necessary in each, I am not able to say much. It is stated in the "Encyclopedia Americana" that one square foot of steam-pipe has been found sufficient to heat two hundred cubic feet of air; but this may have been for the English climate. In Perkins' hot water, called the "high pressure" apparatus, rolled iron pipes are used, hermetically sealed, so that the water is confined and heated to 350° or higher,—consequently much less pipe is required than in those where they are kept at 212°, or a very little over. In London these iron pipes are frequently used for gas, instead of lead, which answers the purpose quite well; so I presume their cost cannot much exceed that of lead pipe. One great advantage of this "high pressure" method is, that all your boiling may be done without the cost and dirt of an extra fire, and in wooden or any other vessels, simply by projecting the pipe from the wall a foot or so, bending it downwards, and making a coil, and returning it upwards and back to the wall. The high temperature of the water circulating within the pipe, will casue that in any vessel placed under it to boil rapidly. It is hardly necessary to state that the pipe, after running and coiling in the partitions of the rooms to be heated, returns into itself somewhat below the level of the fire; so that the water which has given off part of its heat, being denser than that which has but just passed through the fire, gravitates with greater power, and forces up the other, and thus keeps up a constant circulation. Your correspondent will find these various methods detailed at length, in those volumes of the London Mechanics' Magazine, and the London Journal of Arts and Sciences, published since 1827, which volumes he may get from Francis' Library, under Peale's Museum.

It may be well to mention that Mr. Perkins is an American, and perhaps has a patent right in this country. There are other modifications of the hot water principle invented by Englishmen, and therefore not patented here, and which the laws of honor will allow us to use freely, so long as the legal enactments restricting commerce in the products of genius and industry in the two countries are allowed to remain in force.

Your obt. servt.,
J. K. F.

New-York, June 4, 1836.

NOTE.—I had almost forgotten the ques- whether the heat from water pipes is sufficient for the coldest weather in our winters? There will be no difficulty on that score if your pipe is long enough, and your fire hot enough. I have been told that Mr. Perkins says he can heat a whole parish from one fire.

From the Mechanics' Magazine.

STEAM, *versus* WATER.

Few persons even in this age of inquiry and improvement seem to be aware of the vast superiority of steam over every other form of motive power. Many are still, by this assertion, reminded of the anecdote of the famous Brindley. In giving evidence before a Committee of the House of Commons on the subject of Canals, he spoke of their superiority as a mode of communication in such decided terms, that a member asked for what he thought rivers were intended? he unhesitatingly replied, "*to feed canals.*" Now, though we say that the manufacturer will one day "feed his boiler from the falls," we think that the assertion is not a bold one, and that it does admit of proof.

Some time ago, our attention was directed to a comparison of the expense of the two forms of power in the village of Lowell, possessed of the best water power in the Union. The expense of Steam to Water was said to be as 100 to 125.

We have since often had this subject in mind, in reference to the more improved use of steam, and particularly to the economy of the rotary engine of Avery.

Pursuing the comparison, we have collected some of the more prominent disadvantages of the usual hydraulic system, and the corresponding advantage of steam power.

The first item of cost is that of the water right, over and above the value of the ground as increased by any other advantages of locality. This expense is in no case trifling, and sometimes is positively enormous. There is of course no corresponding item of expenditure in the use of steam, an engine working as well on the top of a hill as in the bottom of a valley.

2d. The outlay upon wheels, dams, and other hydraulic works. This is often much greater than would be necessary for the average pressure, provided it were constant—that is, we are to erect works to support much more water than we have supplied through three quarters of the year. Freshets, &c. are to be provided against, at an increased cost. It is well known that in some locations the provision for such contingencies is no small portion of the whole capital employed.

It is this expense, other things being equal, that is to be compared with the cost of an engine, and the comparison is favorable to the latter.

3d. After every precaution, damages from floods are of constant occurrence, and their repair is exceedingly costly.

4th. The delay caused by freshets, &c., producing a stoppage from the too great supply of power.

5th. The delay in seasons of drought, when the supply is insufficient.

These last are most vexatious occurrences, preventing work often times when most is to be done, and the uncertainty arising from the possibility of such delays and accidents, is a constant care to the manager of such an establishment, whereas to the consumer of steam, the perfect certainty of the amount and regularity of the supply of power is a great auxiliary in conducting business.

For a steam engine, the only use of water is a sufficiency for the boiler; and in these days of economy of heat and steam, a very small quantity of fuel is used, and but little water. We have seen a rotary engine, estimated at 15 horse power, evaporating but 40 gallons per hour.

6th. Delay in winter, and in our uncertain climate this may sometimes be considerable, and in an establishment of great extent perhaps fatal.

To balance all these expenses, peculiar to the use of hydraulic power, there is, as far as we can recollect, but one peculiar to that of steam, namely, *fuel*. Now in saw mills this expense is nothing, and in all instances much less than formerly.

Our persevering countryman, Dr. Nott. has already succeeded in greatly reducing this item of cost—and he does not yet appear to be satisfied.

As regards fuel, Avery's Engine has immense advantages over others, inasmuch as the quantity of water used is less than in any other case. The elasticity of the steam operates more advantageously than in any other construction, the small quantity of water used being a proof of this.

In the engine above referred to, the cost for coal was rather less than $1 for ten hours.

It is almost needless to observe that, in many large establishments, manufactories, &c., the application of a portion of the steam to heating, &c., nearly, if not quite, compensates the cost of fuel. The certainty and uniformity of this method of drying goods, have fully established its superiority. Indeed, in the art of dyeing, certain colors owe their brilliancy to the rapid and high heat of steam, and they could be produced in no other way. While speaking of this use of steam, we must notice an engine erected in the Astor Hotel. This is a small engine of 5 horse power; its use is to pump water from the different cisterns to all parts of the house—supply the baths with hot and cold water—clean knives—brush shoes—roast and grind coffee; and the steam cooks the various dishes in the kitchen, and also dries the clothes, which by this method of proceeding are ready for use with unprecedented despatch.

To these and numberless other uses is this engine turned, saving an immense number of servants, a great quantity of fuel, and a vast deal of time.

(The exhaust steam pipe of this engine is over 300 feet long.)

One of the greatest advantages of steam power, in many cases, is, that it admits of change of locality, without injury to the machinery, and often with benefit to the employer.

In this respect again Avery's Engine stands pre-eminent. The machinery is beautifully compact, and consequently portable. An engine of 15 horse power is hardly a load for a horse, the whole weighing less than 600 pounds.

Let us suppose, that a man purchases a piece of timber land, of prime quality, but unfortunately (as is thought) away from any water course.

Let him procure an Avery's Engine; and this, connected with his saw mill, can be placed upon wheels and moved, by the engine itself, if he pleases, to any part of his land. (Mills capable of such an arrangement, and very compact, are now easily to to be procured.)

Let him locate his mill near a spring, and commence operations. The waste and rubbish, that in most cases is a drug, is entirely consumed by the engine; the grouud is cleared, and nothing is to be removed but the perfectly formed timber.

Among other useful applications of such an engine, in the forest itself, no one can be equal in beauty of operation to the valuable *stave machine* of Philip Cornell, N. Y. (A drawing and description of this machine will be found upon the next page.) This machine promises to be of great service. With such an arrangement as that of the saw mill above mentioned, nearly if not quite double the usual number of staves can be cut from the timber before transportation, and these are already dressed and ready for use, either for liquids or solids.

These are only a few of the very many useful applications of this sort of traveling machines. Others will suggest themselves to our readers.

It must be very evident that, whatever brings into use property of little or no value, enabling the produce of such land to compete successfully with that of much better, must add to the wealth of the landholder, or timber merchant, a sum equal to the cost of the best land.

Thus a greater uniformity of value would result, and of consequence a more equal competency to those on or away from great water courses and canals.

Our object is to draw attention to this question, and we should be much gratified if any of our friends would furnish us with such information on the subject as they may have at their command.

This information from various quarters, when collected, might furnish results equally useful and interesting—and we shall feel most happy in becoming the medium of their communication to the public.

AGRICULTURE, &c.

From the Genesee Farmer.

Brief hints for spring work.—Apply manure to corn and potato crops, and not to grain crops.

Let manure be buried as soon as possible after spreading.

When rotted or fermented manure is applied, let it be as thoroughly mixed with the soil as possible.

Wheat thrown out of the ground by frost, should be pressed in again by passing a roller over it.

Ploughing heavy soils when wet, does more injury than if the team were standing idle.

In ploughing green sward deeply, the furrows must always be at least one half wider than deep, else the sods will not turn well.

New meadows should now be rolled.

All grain fields seeded to grass should be rolled.

Barley should be sown as early as possible, upon a light and moderately moist soil, at the rate of one and a half to two bushels per acre, according to the size of the seed.

A roller should be passed over it as soon as it is harrowed, to press the soil around it, and smooth the field.

Barley seed may be freed from intermixed oats by pouring water upon it, when the oats will float, and be skimmed off.

Oats require strong rich soil, good culture, and early sowing.

Preserved leached and unleached ashes which have accumulated during the winter, to be applied to corn in the hill.

To prevent corn being touched by crows, stir the seed with a sufficient quantity of heated tar, and then roll it in plaster, lime or ashes.

Plaster is always most efficacious on light and thin soil—on meadow and clover ground, the earlier it is sown the better.

Plaster when applied to cultivated ground, is best when worked into the soil.

Sowing it broadcast upon Indian corn after it is up, has increased the crop 25 per cent.

Every farmer should attempt the field culture of root crops—he may raise as much cattle food from one acre, as from five acres of meadow.

Farmers who have heavy rich soil, will succeed best with mangel wurtzel—those who have sandy soil, with ruta baga. They should try both.

Sow garden crops in drills where practicable, in order that the weeds may be cleared with a hoe.

Different varieties of melons and squashes should be planted at the greatest possible distance, in order to prevent intermixing and crossing.

Loosen the soil with a spade round fruit trees growing in grass land.

Examine the roots of peach trees and remove all the grubs. Their presence is shown by the gum oozing out.

The last Albany Cultivator says—"Mr. Asa Carter, of Champion, Jefferson Co., has shown us a specimen of silk manufactured by his daughter, who never saw a silk worm, nor a silk reel, till last summer. This is a pretty good evidence that there is no great art or mystery in managing silk worms."

One pound of potash dissolved in two quarts of water and applied to trees, will effectually destroy the bark louse, &c.

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the Engine and its load.	Inclination of the road.	Load of the engine reduced to a level.	Velocity in miles per hour.	Effective pressure in the boiler in pounds per square inch, by the state of the Spring-balance.		State of the Regulator.	Remarks.
1834.		tons.	miles.		lbs.		
July 14, ATLAS, from Liverpool to Manchester,	level - - - - -	124	17.14	57...58	=61	$\frac{3}{4}$	The engine was helped on the inclined plane at $\frac{1}{96}$ by three engines with cylinders of 11 in. diameter.—Weather fair and calm.—Water cold in the tender.
in 1 h. 31′, - - with 25 wagons - - - 118.90 t.	descent $\frac{1}{1094}$	90	21.17	57......	=60	$\frac{3}{4}$	
delays 19′ - - tender - - - - - 5.50	descent $\frac{1}{849}$	80	23.72	57...60	=63	$\frac{3}{4}$	
	ascent $\frac{1}{1300}$	154	18.75	57...59.5	=62.5	$\frac{3}{4}$	
1 h. 50′ 124.40 t.	ascent $\frac{1}{4257}$	133	17.89	57...58	=61	$\frac{3}{4}$	
ATLAS { cylinder - - - 12 in.							
stroke - - - - 16 in.							
wheel - - - - 5 ft. { 6 wheels, 4 coupled							
weight . - - - 11.40 t.							
friction - - - 152 lbs.							
heating surface { fire-box 57.06 sq. ft. tubes 217.88 sq. ft.							
July 16, ATLAS, from Liverpool to Manchester,	level - - - - -	105	15.00	50...52	=54	$\frac{3}{4}$	The engine was helped on the inclined plane at $\frac{1}{96}$ by two engines with 11 in. cylinders.—Weather fair and calm.—Water rather lukewarm in the tender.
in 1 h. 25′, - - - with 20 wagons - - - 99.25 t.	descent $\frac{1}{1094}$	75	21.43	50...51	=54	$\frac{3}{4}$	
delays 5′, tender - - - - - 5.50	descent $\frac{1}{849}$	67	25.07	50...52	=55	$\frac{3}{4}$	
	ascent $\frac{1}{1300}$	129	22.64	50...51.25	=54.25	1	
1 h. 30′ 104.75 t.	ascent $\frac{1}{4257}$	112	19.63	50......	=53	$\frac{3}{4}$	
July 17, ATLAS, from Liverpool to Manchester,	level - - - - -	71	20.00	50......	=53	$\frac{1}{2}$	The engine was helped on the inclined plane at $\frac{1}{96}$ by one engine with 11 in. cylinders.—The axle-box of one of the wagons too tight.—Weather fair and calm.—Water very hot in the tender.
in 1 h. 27′, - - - with 15 wagons - - - 65.4 t.	descent $\frac{1}{1094}$	50	24.54	50...51	=54	$\frac{1}{2}$	
delays 3′, tender - - - - - 5.5	descent $\frac{1}{849}$	44	26.13	50......	=53	$\frac{1}{2}$	
	ascent $\frac{1}{1300}$	89	21.51	50...52	=55	$\frac{1}{2}$	
1 h. 30′ 70.9 t.	ascent $\frac{1}{4257}$	76	20.81	50......	=53	$\frac{1}{2}$	

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the Engine and its load.	Inclination of the road.	Load of the engine reduced to a level.	Velocity in miles per hour.	Effective pressure in the boiler in pounds per square inch, by the state of the Spring-balance.		State of the Regulator.	Remarks.
1834.		tons.	miles.		lbs.		
July 17, ATLAS, from Manchester to Liverpool,							The engine ascended, without help, the inclined plane at $\frac{1}{96}$. On the remainder of the way, the engine drew two wagons more.—Weather fair and calm.—Water very hot in the tender.
in 1 h. 26′ - - - with 8 empty wagons	descent $\frac{1}{4257}$	26	26.47	50...51	=54	$\frac{1}{3}$	
and 3 loaded - - - - 22.45 t.	descent $\frac{1}{1300}$	22	31.43	50...50.5	=53.5	$\frac{1}{3}$	
delays 3′ tender - - - - - 5	ascent $\frac{1}{849}$	36	27.93	50...52	=55	$\frac{1}{3}$	
	ascent $\frac{1}{96}$	114	14.00	50...53	=56	1	
1 h. 29′ 27.45 t.							
July 23, ATLAS, from Liverpool, to Manchester	level - - - - -	196	9 23	50...50.5	=53.5	1	The engine was helped on the inclined plane at $\frac{1}{96}$ by four engines, three with 11 in. cylinders, and one with 14 in. cylinders.—Weather fair and calm.—Water cold in the tender.
in 3 h. 2′ - - - with 40 wagons - - 190 t.	descent $\frac{1}{1094}$	142	14.12	50........	=53	1	
delays 15′ tender - - - - 5.5	descent $\frac{1}{849}$	127	16.21	50........	=53	1	
	ascent $\frac{1}{1300}$	240	8.00	50...51.75	=55	1	
3 h. 17′ 195.5 t.	ascent $\frac{1}{4257}$	209	5.87	50...51.5	=54.5	1	
July 23, ATLAS, from Manchester to Liverpool,							
with 8 wagons - - - - - - - 33.90 t.	ascent - $\frac{1}{96}$	199	6.00	50...52	=55	1	Weather calm.
tender - - - - - - - - - - 5.50							
39.40 t.							
July 31, ATLAS, from Liverpool to Manchester,	level - - - - -	67	20.00	30........	=33.5	1	The engine ascended the inclined plane at $\frac{1}{96}$ with its train in two trips. Weather fair and calm.—In this experiment, the pressure was purposely varied. On the total delay, 26′ were employed in making an experiment.
in 1 h. 44′ - - - with 14 wagons - - - 61.65 t.	descent $\frac{1}{1094}$	59	21.82	30........	=33.5	1	
delays 52′ tender - - - - - 5	descent $\frac{1}{849}$	53	23.26	30...30.33	=34	1	
	ascent $\frac{1}{1300}$	96	19.75	25...27.75	=31	1	
2 h. 36′ 66.65 t.	ascent $\frac{1}{4257}$	84	14.16	20...21.5	=25.5	1	

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the Engine and its load.	Inclination of the road.	Load of the engine reduced to a level.	Velocity in miles per hour.	Effective pressure in the boiler in pounds per square inch, by the state of the Spring-balance.		Remarks.
1834.		tons.	miles.	lbs.		
July 31, ATLAS, from Manchester to Liverpool,	level - - - - -	40	16.38	20...23 = 27.25	1	The engine ascended the inclined plane at $\frac{1}{89}$ without help.—Weather calm. In this experiment, as in the former one, the pressure was lowered on purpose.
in 1 h. 54′ - - - with 8 wagons loaded	descent $\frac{1}{4257}$	37	19.53	20...20.5 = 25	1	
and 4 empty - - - - 35.15 t.	descent $\frac{1}{1300}$	29	23.00	20...20.75 = 25.25	1	
delay ... tender - - - - - 5	ascent $\frac{1}{849}$	57	16.08	20...20.75 = 25.25	1	
	ascent $\frac{1}{89}$	202	7.50	45...47.5 = 51	1	
1 h. 54′ 40.15 t.	ascent $\frac{1}{1094}$	53	15.79	20...20.25 = 24.75	1	
Aug. 4, ATLAS, from Liverpool to Manchester,	level - - - - -	128	15.00	50...... = 53	1	The engine was helped on the inclined plane at $\frac{1}{96}$ by two engines, one with 11 in. cylinders, and the other with 14 in. cylinders.—Weather fair and calm.—Water cold in the tender. We have seen in the experiments on the friction of the engines, that that day, ATLAS had a friction of 194 lbs. instead of 152 lbs.
in 1 h. 58′ - - - with 25 wagons - - 122.64 t.	descent $\frac{1}{1094}$	92	17.14	50...... = 53	1	
delay ... tender - - - - 5	descent $\frac{1}{849}$	82	20.52	50...... = 53	1	
	ascent $\frac{1}{1300}$	158	15.38	50...50.5 = 535	1	
1 h. 58′ 127.64 t.	ascent $\frac{1}{4257}$	137	15.24	50...... = 53	1	
Aug. 4, ATLAS, from Manchester to Liverpool, with 9 loaded wagons						
and 7 empty - - - - - 38.76 t.	ascent $\frac{1}{89}$	219	3.75	57...58.75 = 61.75	1	Weather fair and calm.
tender - - - - 5.50						
44.26 t.						
July 24, FURY, from Liverpool to Manchester,	level - - - - -	56	17.14	31...32 = 55	$\frac{3}{4}$	The engine ascended the inclined plane without help.—Weather fair and calm.—Water cold in the tender
in 1 h. 30′ - - - with 10 wagons - - - 51.16 t.	descent $\frac{1}{1094}$	40	18.00	31...32 = 55	$\frac{3}{4}$	
delay ... tender - - - - 5	ascent $\frac{1}{96}$	244	6.31	32...35 = 65.5	1	
	descent $\frac{1}{849}$	35	23.28	31...32 = 55	$\frac{3}{4}$	
1 h. 30′ 56.16 t.	ascent $\frac{1}{1300}$	70	21.82	31...32.5 = 55.5	$\frac{3}{4}$	
	ascent $\frac{1}{4257}$	60	21.17	31...32 = 55	$\frac{3}{4}$	

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the Engine and its load.	Inclination of the road.	Load of the engine reduced to a level.	Velocity in miles per hour.	Effective pressure in the boiler in pounds per square inch, by the state of the Spring-balance.	State of the Regulator.	Remarks.
1834.		tons.	miles.	lbs.		
FURY: cylinders - - - 11 in.; stroke - - - - - 16 in.; wheel - - - - - 5 ft.; weight - - - - 8.20 t.; friction - - - - 109 lbs.; heating surface: fire-box 32.87 sq. ft., tubes 307.38 sq. ft.						
July 24, FURY, from Manchester to Liverpool,	level - - - - -	49	17.50	31...32 = 55	$\frac{3}{4}$	The engine ascended the inclined plane without help.—Weather fair, a sidewind blowing tolerably hard at intervals.—Water cold in the tender.
in 1 h. 35′ - - - with 10 wagons - - - 43.80 t.	descent $\frac{1}{4257}$	45	21.43	31...32 = 55	$\frac{3}{4}$	
delay ... tender - - - - 5	descent $\frac{1}{1300}$	36	22.00	31...32 = 55	$\frac{3}{4}$	
	ascent $\frac{1}{849}$	68	18.62	31...32 = 55	$\frac{3}{4}$	
1 h. 35′ 48.80 t.	ascent $\frac{1}{89}$	228	15.00	32...36 = 67	1	
	ascent $\frac{1}{1094}$	63	18.46	31...32 = 55	$\frac{3}{4}$	
Aug. 4, FURY, from Manchester to Liverpool,	level - - - - -	38	25.00	28...30 = 52.5	1	The engine went up the inclined plane without help.—Weather fair and calm.
in 1 h. 15′ - - with 8 1st class coaches 32.97 t.	descent $\frac{1}{4257}$	35	25.71	28...31 = 54	1	
delays 9′ tender - - - 5	descent $\frac{1}{1300}$	28	26.94	28...30.25 = 53	1	
	ascent $\frac{1}{849}$	53	24.61	28...30 = 52.5	1	
1 h. 24′ 37.97 t.	ascent $\frac{1}{89}$	183	13.33	28...33 = 55	1	
	ascent $\frac{1}{1094}$	50	24.82	28...30 = 52.5	1	
Aug. 15, FURY, from Manchester to Liverpool,	level - - - -	138	10.91	31...32.5 = 55.5	1	The engine only travelled that part of the road with this train. Its fire was in its greatest activity only towards the end of the journey. It had, besides, the impulse proceeding from the descent of the plane at $\frac{1}{96}$.—Weather fair.—Rails muddy.
with 28 wagons - - - 132.73 t.	ascent $\frac{1}{1094}$	176	13.33	31...32.5 = 55.5	1	
tender - - - - - 5.50						
138.23 t.						

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the Engine and its load.	Inclination of the road.	Load of the engine reduced to a level.	Velocity in miles per hour	Effective pressure in the boiler in pounds per square inch, by the state of the Spring-balance.	State of the Regulator.	Remarks.
1834.		tons.	miles.	lbs.		
July 26, Firefly, from Liverpool to Manchester,	level - - -	41	24.00	17... ... = 50	1	The engine was in bad order, and was going to be repaired. It was helped on the inclined plane at $\frac{1}{96}$ by another engine with 11 in. cylinders. Weather fair.—Water almost cold in the tender.
in 1 h. 35′ - with 8 1st class coaches 36.40 t.	descent $\frac{1}{849}$	25	25.45	15... ... = 45	1	
delays 5′ tender - - - - 5	ascent $\frac{1}{1300}$	52	21.29	15... ... = 45	1	
——	ascent $\frac{1}{4257}$	45	21.33	11... ... = 35	1	
1 h. 40′ 41.40 t.						
Firefly { cylinders - - - 11 in.						
stroke 18 in.						
wheel 5 ft.						
weight - - - - 8.74 t.						
friction - - - - 119 lbs.						
heating surface { fire-box 43.91 sq. ft.						
tubes 362.60 sq. ft.						
July 26, Firefly, from Manchester to Liverpool,	level - - -	41	25.71	17...18 = 50.33	$\frac{1}{2}$	The engine was in bad order. It was helped on the inclined plane at $\frac{1}{89}$ by an engine with 11 in. cylinders.—Weather rainy; wind tolerably strong against the direction of the engine.
in 1 h. 18′...with 8 1st class coaches 36.40 t.	descent $\frac{1}{4257}$	38	23.68	15.. ... = 45	$\frac{1}{2}$	
delay 5′ tender - - - - 5	descent $\frac{1}{1300}$	31	24.44	17...18 = 50.33	$\frac{1}{2}$	
——	ascent $\frac{1}{849}$	58	23.44	17...18.5 = 50.5	$\frac{1}{2}$	
1 h. 23′ 41.40 t.	ascent $\frac{1}{1094}$	54	24.82	17.. ... = 50	$\frac{1}{2}$	
Aug. 1, Vesta, from Liverpool to Manchester,	level - - -	49	24.00	20...21.5 = 52	1	The engine ascended, without help, the inclined plane, at $\frac{1}{96}$, until about 60 yds. from the top. It was hauled up the remainder of the ascent.—Weather calm.—Water warm in the tender. The delay of 30 minutes on the road was occasioned by an experiment made on the engine.
in 1 h. 22′ - - - with 10 wagons - - - 43.72 t.	descent $\frac{1}{1094}$	34	29.09	20...21 = 50	1	
delays 30′ tender - - - - 5	descent $\frac{1}{849}$	30	27.00	20...21 = 50	1	
——	ascent $\frac{1}{1300}$	61	23.56	20...21.5 = 52	1	
1 h. 52′ 48.72 t.	ascent $\frac{1}{4257}$	52	25.71	20...21 = 50	1	

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the engine and its load.	Inclination of the road.	Load of the engine reduced to a level	Velocity in miles per hour.	Effective pressure in the boiler in pounds per square inch, by the state of the Spring-balance.	State of the Regulator.	Remarks.
1834.		tons.	miles.	lbs.		
Vesta { cylinders - - - $11\frac{1}{2}$ in.						
stroke - - - - - 16 in.						
wheel - - - - - 5 ft.						
weight - - - - 8.71 t.						
friction - - - - 187 lbs.						
heating surface { fire-box 46.00 sq. ft.						
tubes 256.08 sq. ft.						
Aug. 1, Vesta, from Manchester to Liverpool,	level - - -	33	29.00	20...21 = 50	1	The engine ascended the inclined plane at $\frac{1}{96}$ without help.—Weather fair. Wind moderate, in favour of the motion.—Water very hot in the tender.
in 1 h. $5\frac{1}{2}$′ - with 5 loaded wagons	descent $\frac{1}{4257}$	30	30.00	20...21 = 50	1	
and 5 empty - - - 28.15 t.	descent $\frac{1}{1300}$	24	34.74	20...21 = 50	1	
delay ... tender - - - 5	ascent $\frac{1}{849}$	47	28.93	20...21 = 50	1	
——	ascent $\frac{1}{89}$	165	14.11	20...22.5 = 55	1	
1 h. $5\frac{1}{2}$ 33.15 t.	ascent $\frac{1}{1094}$	44	28.80	20...21 = 50	1	
Aug. 16, Vesta, from Manchester to Liverpool,	level - - -	94	15.00	20...21.5 = 52	1	The engine drew a part of its train on the inclined plane at $\frac{1}{89}$. The remainder was drawn by an additional engine.—Weather fair and calm Water lukewarm in the tender. The delays that occurred in th journey were occasioned by several trials made with the engine.
in 1 h. 42′ with 20 wagons - - - 88.35 t.	descent $\frac{1}{4257}$	87	18.46	20...22 = 53.25	1	
delays 1 h. 10′ tender - - - 5.50	descent $\frac{1}{1300}$	71	24.00	20...22 = 53.25	1	
——	ascent $\frac{1}{849}$	129	12.10	20...22.5 = 55	1	
2 h. 52′ 93.85 t.	ascent $\frac{1}{1094}$	121	18.75	20...21.5 = 52	1	
Aug. 16, Vesta, from Manchester to Liverpool,	ascent $\frac{1}{89}$	183	3.25	20...23.5 = 58	1	Weather calm.—Water lukewar in the tender.—These eight wagon were part of the train of the formet experiment.
with 8 wagons - - - 31.75 t.						
tender - - - 5.50						
——						
37.45 t.						

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the engine and its load.	Inclination of the road.	Load of the engine reduced to a level.	Velocity in miles per hour.	Effective pressure in the boiler in pounds per square inch, by the state of the Spring-balance.		State of the Regulator.	Remarks.
1834.		tons.	miles.		lbs.		
Aug. 16, Vesta, from Manchester to Liverpool,	ascent $\frac{1}{89}$	189	3.00	20...23	= 56.5	1	Weather fair and calm.
with 8 loaded wagons							
and 4 empty - - - - 34.05 t.							
tender - - - - 5.00							
39.05 t.							
Aug. 15, Leeds, from Liverpool to Manchester,	level - - -	88	18.26	31...32.75	= 54.75	$\frac{3}{4}$	The engine was helped for the passage of the inclined plane at $\frac{1}{89}$ by an engine with 14 in. cylinders.—Weather calm.—Water rather less than lukewarm in the tender.
in 1 h. 35′ - - with 20 wagons - - - 83.34 t.	descent $\frac{1}{1094}$	64	20.72	31...32	= 54	$\frac{3}{4}$	
delay ... tender - - - 5	descent $\frac{1}{849}$	57	24.00	31...32	= 54	$\frac{3}{4}$	
	ascent $\frac{1}{1300}$	109	20.34	31...32	= 54	$\frac{3}{4}$	The regulator was not quite opened, because the engine is subject to prime, that is to say, to drive the water of the boiler into the cylinder with the steam.
1 h. 55′ 88.34 t.	ascent $\frac{1}{4257}$	95	18.82	31...32	= 51	$\frac{3}{4}$	
Leeds: cylinder - - - 11 in.							
stroke - - - - 16 in.							
wheel - - - - 5 ft.							
weight - - - - 7.07 t.							
friction - - 108 lbs.							
heating surface: fire-box 34.57 sq. ft.; tubes 307.38 sq. ft.							
Aug. 15, Leeds, from Manchester to Liverpool,	descent $\frac{1}{4257}$	37	24.54	28...30	= 51.5	$\frac{3}{4}$	The engine ascended, without help, the inclined plane at $\frac{1}{89}$. Weather fair and calm.—Water very hot in the tender.
in 1 h. 17½′ — 1st half of the way: 8 wagons 34.38 t.	descent $\frac{1}{1300}$	30	30.00	25...27	= 46.5	$\frac{3}{4}$	
delay 3′ — tender - - 5.50	ascent $\frac{1}{849}$	55	25.31	25...27	= 46.5	$\frac{3}{4}$	
1 h. 20½′ — 39.88 t.							
2d half of the way: 7 wagons 29.65 t.	level - - -	35	22.50	25...27	= 46.5	$\frac{3}{4}$	
tender - - 5.50	ascent $\frac{1}{89}$	168	10.00	28...29	= 48.5	1	
35.15 t.	ascent $\frac{1}{1094}$	46	25.71	28...32	= 54	$\frac{3}{4}$	

EXPERIMENTS ON THE VELOCITY AND LOAD OF THE ENGINES.

Date of the Experiment and Designation of the Engine and its load.	Inclination of the road.	Load of the engine reduced to a level.	Velocity in miles per hour.	Effective pressure in the boiler, in pounds per square inch, by the state of the Spring-balance.		State of the Regulator.	Remarks.
1834.		tons.	miles.		lbs.		
Aug. 15, Leeds, from Liverpool to Manchester,	level - - -	38	21.81	25...28	= 47.5	$\frac{3}{4}$	The engine, while ascending, without help, the inclined plane at $\frac{1}{89}$ with its load, stopped near the top. It was hauled up the remainder of the ascent. Weather fair and calm.—Water lukewarm in the tender.
in 1 h. 29′ - - with 7 wagons - - - 33.52 t.	descent $\frac{1}{1094}$	27	29.09	31...32	= 54	$\frac{3}{4}$	
delay 36′ tender - - - 5	descent $\frac{1}{849}$	23	28.96	25...28	= 47.5	$\frac{3}{4}$	
	ascent $\frac{1}{1300}$	48	21.43	15...16	= 29	$\frac{3}{4}$	
2 h. 5′ 38.52 t.	ascent $\frac{1}{4257}$	41	18.75	25...27	= 46.5	$\frac{3}{4}$	The delay that occurred on the road was occasioned by a trial made with the engine.
July 22, Vulcan, from Manchester to Liverpool,						1	
with 9 1st class coaches - - 34.07 t.							
tender - - 5	ascent $\frac{1}{89}$	188	11.42	31...36	= 57.5		Weather calm.—Water scarcely lukewarm in the tender on leaving Manchester.
34.07 t.							
Vulcan: cylinders - - - 11 in.							
stroke - - - - 16 in.							
wheel - - - - 5 ft.							
weight - - - - 8.34 t.							
friction - - - 136							
heating surface: fire-box 34.45 sq. ft.; tubes 307.38 sq. ft.							
July 22, Vulcan, from Liverpool to Manchester,						1	Weather fair.—A very slight wind against the motion of the engine.—Water cold in the tender.
with 9 1st class coaches - - 36.32 t.	ascent $\frac{1}{89}$	186	18.75	31...36	= 57.5		
tender - - 5							
41.32 t.							

These experiments show better than any possible reasonings, what may be expected of locomotive engines in a daily work. That is the reason why we have joined them all together in this place.

Their coincidence with the table of velocities, deduced from calculation, will be remarked.

§ 2. *Of the Velocity of the Maximum useful Effect.*

We have seen above (Chap. V. Art. V. § 2) that the load an engine is able to draw, at a given speed, is expressed by

$$M = \frac{m\,SPD - \rho\, d^3\, lV}{(\delta + n)\, V\, D} - \frac{F}{\delta + n}.$$

If we multiply the two members of this equation by V, we have

$$MV = \frac{m\,SPD - \rho\, d\ \, lV}{(\delta + n)\, D} - \frac{FV}{\delta + n}.$$

The produce MV, of the load multiplied by the velocity with which that load is drawn, represents the *useful effect* produced by the engine in the unit of time. We see consequently, here, that that useful effect will be so much the greater as the speed is less; for in the second member that speed only appears in the negative terms. As, on the other hand, the engine cannot without considerable loss of steam, move at a velocity less than that which corresponds to the quickness with which the steam is generated in the boiler, it follows that the *maximum* of useful effect will take place at that speed.

By examining the above table, under the same point of view, we ascertain by experience what has already been proved by calculation, viz., that the greatest useful effect is produced at the least velocity.

Let us take, for instance, an engine with an eleven-inch cylinder, working 10 hours a-day. At its greatest speed, of 30 miles an hour, it will be able, with an effective pressure of 50 lbs. per square inch in the boiler, to draw 50 t.; and at its least speed, with an equal pressure in the boiler, it will draw 160 t.

By drawing trains of 50 t. at a velocity of 30 miles an hour, it will, in its 10 hours' work, have drawn 50 t. to a distance of 300 miles, or, in other words,

15,000 t. to the distance of one mile.

By drawing trains of 160 t. at a speed of 15.5 miles an hour, it will, in the same space of time, have taken 160 t. to a distance of 155 miles, which is equal to

24,800 t. to the distance of one mile.

There is, consequently, a considerable advantage to be reaped, in making the engines, if possible, work with the greatest loads, which correspond with the least speeds. It must be remarked, that the difference between the two effects would have been still greater, if from each load we had deducted the tender, as making, in regard to the useful effect, a part of the engine, and not of the train.

It is scarcely necessary to add, that when the speed becomes the express condition of the haulage, as, for instance, in respect to passengers, these considerations are no longer applicable. We speak here only theoretically.

The difference we have found in the useful effect produced, is owing to the circumstance that in the two cases the resistance proper to the engine remained nearly the same, while in the first case it had to be moved 300 miles, and in the second only 155 miles. The same is true in regard to the atmospheric pressure, which forms a part of the resistance on the piston. The engine having travelled in one circumstance double the distance of the other, was naturally obliged to give a double number of strokes of the piston; and as at each of these strokes of the piston the atmospheric pressure must be overcome, we see that the expense of moving power necessary to conquer the resistance of the atmosphere is in the proportion of the numbers 300 and 155; that is to say, that that force, as well as the force required to move the engine, is in proportion to the velocity of the motion. This is a further proof that, in calculating the effect of these engines, one cannot, as is usually the case, neglect, in all circumstances, the atmospheric pressure; and that it is only in those cases in which the speed is not taken into account that that simplification can take place without mistake.

If we sometimes find calculations of the power of locomotive engines, or any other sort of steam engines, in which there appears what is termed *lost power;* that is to say, calculations according to which it would appear that these engines produce in practice only one-third or even a quarter of what is termed their *theoretical power;* and if that difference between practice and theory be at present so generally established, that it is taken as a rule to say that *practical horses* are only the third part of *theoretical horses*, the reason is, simply, that this supposed theoretical power is wrongly calculated. All the different circumstances of which we have spoken above have not been duly taken into account. Before all calculations, the atmospheric pressure has been deducted; the resistance of the engine, or its increase in proportion to the load, has been omitted; and, above all, the pressure on the piston has been calculated as equal to the pressure in the boiler, though we have seen how different they are from each other. With so many causes of error, it is not surprising that results should have been obtained, which are contradicted by experience; or, in other words, that one should construct very good engines without being able to calculate their power or effects. But if we take into account all the resistances really conquered, and the velocity of their points of application; if we take the pressure in the cylinder as it really is, instead of considering a power as applied when it is not; in that case we shall obtain a most remarkable result, applicable, moreover, to all sorts of steam-engines, viz. that all the power applied is to be traced in the effect produced, and that there is not one single pound of which the use may not be pointed out.

CHAPTER VI.

OF SOME ACCESSORY DISPOSITIONS AND THEIR EFFECT.

ARTICLE I.

OF THE REGULATOR.

§ 1. *Effect of the opening of the Regulator.*

Three accessory parts or dispositions are still to be considered, which have a considerable influence on the effect of locomotive engines; these are the *regulator*, the *blast-pipe*, and the *lead* of the slide, which we are going to describe successively.

We have observed that the pipe, which leads from the boiler to the cylinders, may be either completely or partially shut by means of a cock or regulator. When the regulator is quite open, the steam enters into the cylinder as freely as the area of the pipe through which it must necessarily pass. Then the speed is as great as the generation of steam permits. If, by means of the regulator, we diminish a little the entrance of the pipe, the steam may take at first a greater velocity, which surplus of velocity may allow, as before, the egress of all the steam generated. In that case the effect will remain the same as in the former one, and as long as the width of the passage is not out of proportion with the generation of the steam, there will be no diminution in the effect of the engine.

If, however, we continue to shut the passage, we shall necessarily arrive at last at a point where it will be so narrow, that it will form a considerable obstacle to the admission of the steam. From that moment, only a portion of the steam generated in the boiler will be able to get into the cylinders, and consequently the effect produced will be diminished in the same proportion.

Having called *effective* evaporating power the mass of steam the engine is able to introduce into the cylinders in a unit of time, we clearly see that the motion imparted to the regulator causes a diminution in the effective evaporating power of the engine; and then the formula, such as we have given it above, shows why the effect is diminished.

In fact, we find in practice that the same train will be drawn by the same engine at different speeds, according to the size of the aperture of the regulator. This is the method invariably used on the Liverpool Railway to prevent the trains, when they are too light, from being carried along with greater rapidity than the preservation of the engines, the carriages, and the Railway can allow. This manner of regulating the speed is so far advantageous, that, if on the road there occur either a slight inclination or any obstacle whatever, one may, by opening the regulator, and animating at the same time the fire, restore to the engine its full power, and enable it to pass over the obstacle without diminishing its speed.

The size of the aperture of the regulator is, therefore, to be taken into account, when the question is to ascertain the effect of the engine. That is the reason why we have noted it in the experiments related above.

We should have preferred the handle of the regulator to have turned on a graduated circle, in order to be able to measure exactly the degree of opening, and compare it with the corresponding effects; but, with the present construction of the engines, it is only by approximation that we can judge of the size of the aperture.

§ 2. *Of the Steam Pipes.*

Carrying still further the same principle, on the free motion of the steam, we see that between two engines, perfectly similar in other respects, there must be an advantage in favor of that one in which the steam-pipes have a more considerable area. It is, however, clear, that as soon as we have attained a diameter sufficient for the passage of all the steam that a boiler is able to generate, at the greatest speed with which the engine is required to go, nothing further is to be gained by augmenting still more that diameter. It is for the same reason that we have seen, a little while ago, that that passage may be reduced to a certain degree without loss of effect, which is owing to the opening having been originally greater than was necessary.

Experience has fixed the diameter that must be given to the steam-pipes, and would quickly give notice if it were not observed; for if it should happen, for instance, that an engine, running with all its speed, should still emit steam through its safety-valve, that would be a proof that the area of the passage is too small for the quantity of steam the boiler is able to generate.

§ 3. *Table of the Dimensions of the Steam-Pipes in some of the Engines of the Liverpool and Manchester Railway.*

There exists, then a suitable diameter, harmonizing with the evaporating power of the engine, or with the dimensions of the boiler. It is for that reason we give here the diameter of the steam-pipes, in the engines we have submitted to experiment, and in some others, the proportions of which were given at the beginning of this work. The steam-pipes considered here are those which lead separately from the boiler to each slide-box. Those which lead afterwards from that box to the interior of the cylinders have a corresponding area, although of a different form. Their dimensions will be, for instance, 1 inch broad to 7 inches long, which will present the same surface, as a tube of 3 inches diameter.

DIAMETER OF THE STEAM-PIPES IN SOME OF THE ENGINES OF THE LIVERPOOL AND MANCHESTER RAILWAY.

Name of the Engine and Number of its construction.	Diameter of the Cylinder.	Stroke of the Piston.	Heating-surface: Exposed to the action of Radiating Caloric.	Heating-surface: Exposed to the action of Communicative Heat.	Inside Diameter of the Steam-Pipes.	Remarks.
	inches.	inches.	sq. ft.	sq. ft.	inches.	
SAMSON, No. 13	14	16	40.20	416.90	3.25	This engine is now under repair, and the steam-pipes will be 4 inches in diameter.
GOLIATH, No. 15	14	16	40.31	407.00	3.25	
ATLAS, No. 23	12	16	57.06	217.88	3.25	
VULCAN, No. 19	11	16	34.45	307.38	3.50	
FURY, No. 21	11	16	32.87	307.38	3.50	
VESTA, No. 24	11	16	46.00	256.08	3.25	
LEEDS, No. 30	11	16	34.57	307.38	3.50	
FIREFLY, No. 31	11	18	43.91	362.60	3.00	

ARTICLE II.

OF THE BLAST-PIPE.

In describing the engine, we have said that the steam, after having produced its effect in the cylinder, is let into the chimney. It enters it in a jet, through a pipe turned upwards, and terminated by a narrow orifice, which is placed in the middle of the chimney-flue. The disposition of that pipe, called the *blast-pipe*, is represented in fig. 5.

The steam, at each jet, clearing before it the column of air that filled the passage of the chimney, leaves a vacuum behind it. This vacuum is immediately filled up with a mass of exterior air that rushes through the fire-place to occupy the space where the vacuum has been made. In consequence, after each aspiration thus produced, the fuel in the fire-place grows white with the intensity of the heat.

This effect is similar to that of a pair of bellows that would constantly animate the fire, and the artificial blast created by that means in the fire-place is so necessary to the work of the engine, that if the pipe happens to be broken, burnt, or leaky, the engine becomes almost useless; which shows that the ordinary draft of the chimney is very small in comparison.

It is easy to conceive, that the narrower the orifice, the more violent will be the current that escapes through it, and the greater its effect in animating the fire. The result is, consequently, a greater generation of steam in the same space of time, or an increase of power in the engine. This is, therefore, an important point to note when the effect produced by an engine is to be described; for if the diameter of the blast-pipe is changed, the evaporating power of the boiler will be changed also.

In the engines that served for the above experiments, the diameter of the orifice of the blast-pipe was $2\frac{1}{4}$ to $2\frac{1}{2}$ in., which is their usual dimension. The LEEDS engine must, however, be excepted from the general rule, the diameter of her blast-pipe being only $2\frac{3}{16}$ in. As for the ATLAS engine, her blast-pipe was $2\frac{15}{16}$ in. in diameter in all the experiments, except on the 4th of August, when it had been carried to $3\frac{1}{16}$ in., in order to observe what reduction would result from that circumstance on the effect of the engine. Comparing that experiment with the others made with the same engine, the diminution of speed seems to have been nearly in the proportion of 15 to 17. The effect produced would thus be in the inverse proportion of the square of the diameter of the pipe, or of the area of the orifice; that is to say, in a direct ratio to the velocity with which the steam escapes into the chimney.

To those dimensions, therefore, as to one of the elements of production, must be referred the evaporation effected by the engines.

The generally adopted dimensions of $2\frac{1}{4}$ to $2\frac{1}{2}$ in. diameter for the orifice of the blast-pipe is the result of experience. It has been endeavored to diminish the aperture as much as possible, without putting a material obstacle to the escaping of the steam; that is to say, that the tube has been narrowed as long as the effect was seen to augment, and that a stop was put to the trial as soon as it was found that there was no more gain of power.

With an orifice $2\frac{1}{2}$ in. in diameter, or 5 sq. in. area, and cylinders of 11 in. diameter, or 190 sq. in. total area; that is to say, with an orifice which is only $\frac{1}{38}$ of the area of the cylinders, we see, that in order that all the steam may get out by that passage, its speed in passing through the orifice must be 38 times as great as it was in the cylinder.

The velocity of the jet formed in the chimney will then be, for the dimension we consider, equal to 38 times the velocity of the piston, or in other words, equal to $6\frac{1}{2}$ times the speed of the engine, this latter speed being nearly six times as great as that of the piston.

Thus the power of this additional means will be greater in proportion as the velocity of the engine itself will be more considerable. If, for instance, the engine travels 30 miles an hour, the velocity of the jet will be 195 miles an hour, or 286 feet per second; and as that velocity cannot be produced merely by the tendency of the steam to escape into the atmosphere, a part of the power of the engine itself must necessarily, in those great speeds, be spent in expulsing the steam; that is to say, in blowing the fire in the fire-place. Consequently, the increase of effect being produced by a sacrifice of power, a point will naturally come where the profit is balanced by the expense required to obtain it, and there all advantage will cease. This explains the point determined by practice as the limit of the narrowing of the orifice.

ARTICLE III.

OF THE LEAD OF THE SLIDE.

§ 1. *Nature and Effects of the Lead.*

The third disposition which we have to discuss, is the *lead* of the slide.

In describing the different parts of the engine, we said that it is the slide that opens and shuts successively the passages above and below the piston, so as to apply the effort of the steam alternately on one side and on the other. If the engine were regulated, as it appears natural that it should be, the slide would keep the passage open to the steam until the piston had reached the bottom of the cylinder. At that instant the change would take place. The first passage would be shut, and the opposite passage opened. Then the motion of the slide would accompany exactly that of the piston. Their alternation would be strictly simultaneous.

But this is not the case; it has been found by experience, that the engine is capable of acquiring a greater speed when the motion of the slide precedes that of the piston; that is to say, when it opens the passages to the steam a little before the necessary moment. When the engine is regulated in that manner, at the moment the piston is going to begin a new stroke, the passages, instead of beginning to open, have already a certain degree of aperture. This premature degree of aperture is called the *lead of the slide*, because it indicates in how far the motion of the slide precedes that of the piston. In fact, we can conceive, that if the return of the slide is, for instance, a quarter of an inch in advance on that of the piston, the passages for the steam will have a quarter of an inch aperture when the piston touches the bottom of the cylinder.

The effect of that disposition, first on the speed and then on the load, are the two points we intend to examine here.

The common way of explaining the increase of speed the engine acquires when it has a little lead, is by saying, that by that means the steam is ready to act on the piston at the moment the piston begins its stroke. But it is not difficult to see, that if the steam really acts quicker at the beginning of the stroke, it is also sooner interrupted at the end of the stroke. The effect would thus only be, to add on one side what is substracted on the other. That explanation is, therefore, by no means satisfactory.

But the manner in which the calculation of the speed of the engines has been established here-above, gives us immediately the real explanation of the fact.

If the change in the passages of the steam, instead of occurring exactly at the end of the stroke of the piston, takes place, according to our supposition, at the moment the piston is still an inch from the bottom, from that instant no more steam enters the cylinder. In fact, on one side the passage is shut; it is true that it is open on the other, but the piston, which must necessarily finish its stroke, keeps the steam pressed back in the passages, from whence it cannot get out until the piston begins to take its retrograde direction. Thus, in regard to the quantity of steam admitted in the cylinders at each stroke of the piston, the length of that stroke is in reality diminished by an inch. We have seen that, to know the velocity of the piston, we must divide the mass of steam generated in the boiler by the area of the cylinders (Chap. V. Art. V. § 1,) and that the quotient will be the speed with which that volume of steam must necessarily pass through the cylinders, or the velocity of the piston. That will really give the velocity wanted, if the steam issues without any interruption; but if, as it is here the case, there occurs at each stroke a suspension in the issuing of the steam, it is evident that, for the same quantity of steam to go through the cylinders, a greater velocity of motion will be required. It is the generation of steam in the boiler that regulates and limits the speed; if, therefore, we suppose that the generation supplied m cylinders full of steam in a minute, when the total length l of the cylinder got filled with steam, that the length $l-\epsilon$ only gets filled, the same quantity of steam will fill per minute a number of cylinders expressed by $m \times \frac{l}{l-\epsilon}$. Then the speed of the piston will be augmented in the inverse proportion of the length of the cylinders that get full of steam.

We see why the lead is favorable to the speed. But if there be profit in that respect, there is loss in regard to the load that the engine is able to draw.

Suppose the line E D (fig. 25) represents the stroke of the piston, and that the stroke takes place in the direction of the arrow. The passage being shut on one side of the piston a little before it is opened on the other side, as we shall see below, let A be the point where the piston is, when the arrival of the steam is intercepted on the side E, and let C be the point where it is when the slide begins to admit the steam on the opposite side, that is to say, on the side D.

It is clear, that at the instant the piston reaches the point A, the moving power that produced the motion is suppressed. Moreover, when the piston, continuing its stroke by virtue of its acquired velocity, reaches the point C, not only has it ceased receiving any impulsion in the direction of the motion, but it suffers even an opposition from the steam admitted in a contrary direction. The piston, however, cannot stop. It must finish its stroke. It must, therefore, repulse that fresh steam that opposes it. As it necessarily spends in the conflict a force equal to that which the steam would have communicated to it, the consequence is, that during the space C D there is not only suspension of the action of the moving force, but even introduction of that moving force in a contrary direction, and in the same proportion destruction of the force previously acquired.

We see, therefore, that the effect of the moving power, in regard to the motion, is only produced on the length of the stroke, first diminished of A D, and then of C D; so that, if those two distances are represented by ϵ and a, the effect we are really entitled to expect from the engine is only in proportion of a stroke $l-\epsilon-a$.

Now we have seen (Chap. V. Art. V. § 4) that the limit of load an engine can draw, is determined by calculating the pressure on the piston as equal to the pressure in the boiler, or expressed by —

$$M = \frac{(P - \rho_i)\, d^2 l}{(\delta + n)\, D} - \frac{F}{\delta + n},$$

expression in which l represents the stroke of the piston. It is clear, that the limit of load will be smaller in proportion as the stroke is diminished, and that setting aside the friction of the engine, or the term $\frac{F}{\delta+n}$, the load will be reduced in proportion to the length of the stroke.

Thus we see what are the effects of the *lead*.

The *maximum* load the engine is able to draw becomes less considerable, and its diminution is very nearly in the proportion of $\frac{l-a-\epsilon}{l}$.

On the other hand, for all loads that remain below that limit, the engine increases its speed in the proportion of $\frac{l}{l-\epsilon}$.

The surplus of effect produced in the latter case is by no means surprising. It is the natural effect of the diminution of the stroke, which enables the same mass of steam generated in the boiler to supply a greater number of cylinders in one case than in the other; and the general formula of the velocity for a given load shows it at first sight. That formula is (Chap. V. Art. V. § 1.)

$$V = \frac{m\, P\, S\, D}{(F + \delta M + n M)\, D + \rho\, d^2 l}.$$

The quantity l, which represents the stroke of the piston, only enters in the denominator. Thus, the shorter the stroke, the greater will be the velocity of the motion with the same load.

A similar effect may, besides, have been already observed in the engines. We mean the effect which results from the difference in the diameter of the cylinder. Between two engines, the cylinders of which have 12 and 11 inches diameter, all things being equal besides, the first will be able to draw a more considerable load; but with equal loads inferior to those limits, the 11-inch engine will have the greatest speed. These results are shown by the above-stated formula, and can be explained in the same manner as the effects of the lead.

§ 2. *Calculation of the Effects of the Lead.*

This is sufficient when we only wish to explain the causes of observed effects. But if we want to calculate *a priori*, and know exactly the effects of a given lead, it is necessary to ascertain the precise measure of the distances a and ϵ. That is to say, that we must determine the situation of the piston corresponding with that of the slide, at the moment that it intercepts or opens the passages.

To be able to determine the comparative situations of the slide and the piston, four circumstances already explained in the description of the engine (§ 6, 7, 8,) and which form the connexion of motion between those two parts of the mechanism, must be clearly kept in mind. (See fig. 9 and 10.)

The slide moves backwards and forwards on the three apertures of the cylinder. It goes alternately from one of its

extreme positions to the other without stopping.

This motion is produced by the revolution of the radius of the eccentric round the axis of the axle tree, which makes the effect of a common crank. But as the communication between the eccentric and the slide takes place by means of a cross-head, the slide is pushed forward when the eccentric is behind, and *vice versa*.

The radius of the eccentric stands at right angles with the crank; the consequence is, that when the crank is horizontal, the eccentric is, on the contrary, vertical, and consequently the slide is in its middle position. *Vice versa*, when the crank is vertical, the eccentric is horizontal, and the slide in its extreme position.

Finally, the piston is exactly at the end of its stroke when the crank is horizontal. Thus, it results from the preceding article that the middle position of the slide corresponds with the end of the stroke of the piston. These different effects are represented in fig. 9 and 10.

From these coincidences we see that, when the slide is in its middle position (fig. 10), the eccentric is vertical, the crank horizontal, and the piston at the end of its stroke.

When the slide is in one of its extreme positions (fig. 9) the eccentric is horizontal, the crank vertical, and the piston in the middle of the cylinder.

We see, moreover, that if the slide had no lead at all, that is to say, if the eccentric were to stand rigorously at right angles with the crank, the middle position of the slide would correspond exactly with the end of the stroke of the piston. If it deviates a little from the perpendicular, that is to say, if the slide reaches its middle position a little before the piston gets to the bottom of the cylinder, the difference will exactly be the lead we are considering.

This being granted, let us take the slide when it is in its middle position, and consequently, when the eccentric is exactly in the vertical. At that moment all is shut, as we see represented in fig. 10 and 26. But the dimensions of the slides being such that on all the openings there exists a small lap, which is generally $\frac{1}{8}$ of an inch, we see the passages were already shut an instant before this, viz. $\frac{1}{8}$ of an inch before the slide had reached this position. Thus the direction of its motion being marked by the arrow, when the slide was in the position *a* (fig. 26) all the passages began to be shut, and the steam was consequently intercepted. This is then the point at which the action of the lead begins, or which corresponds with the point A of the stroke of the piston in fig. 25.

While the slide passes from the position *a* to the position *b*, and afterwards to the position *c*, every thing remains in the same state; but once arrived at the point *c*, the passage on the right side begins to open and admit the steam on the opposite side of the piston. This is then the point corresponding with the one we have designated by C in the motion of the piston.

After having passed that point *c*, the slide continues to open more and more a passage to the steam. If the lead is $\frac{5}{8}$ of an inch for instance; that is to say, if the slide opens the passage to an extent of $\frac{5}{8}$ of an inch, at the instant the piston finishes its stroke, then in measuring from the point *c* a distance of $\frac{5}{8}$ of an inch, we shall find the point *d* where the slide will be the moment the piston is at the bottom of the cylinder. This point will consequently correspond with the one designated by D in fig. 25; that is to say, it will correspond with the end of the stroke of the piston.

This correlativeness once established, we have to determine the unknown distances AD and CD, taken on the stroke of the piston, according to the distances *ac cd*, taken on the range of the slide. These last are in fact given, the second being the lead, and the first the same lead augmented by twice the lap *ab*.

Now, if we suppose the motion of the slide backwards and forwards to be 3 in., the eccentric must produce that motion, and consequently the interval between its centre and the centre of the axle must be $1\frac{1}{2}$ in. The centre of the eccentric describes consequently round the axle a circle, the diameter of which is 3 in., while the crank of the axle describes a circle, the diameter of which is 16 in., which we suppose to be the length of the stroke.

If, therefore, we take the point *b* (fig. 27) for the centre of the axis, and if round that point we describe a circle, the radius of which be $1\frac{1}{2}$ in., that circle will be the one described by the eccentric; and its diameter will be the space run over by the slide. If round that point we describe another circle with a radius of 8 in., it will be the circle described by the crank; and its diameter will be the stroke of the piston.

These points acknowledged, since the middle situation of the slide corresponds with the moment the eccentric is vertical, we see that that position of the slide is here the point *b*. As, besides, we have seen that in consequence of the slide lapping over the apertures, the steam is intercepted an instant before, if we take before the point *b* a space equal to the lap, we shall have the point *a* where the effect of the lead begins. In the same way, if we take beyond the point *b* another space, also equal to the lap, we shall have the point *c* where the passages open again. And, finally, at a distance from the point *c* equal to the lead, we shall have the point *d*, which corresponds with the end of the stroke of the piston.

Raising from these points perpendicular lines towards the circumference described by the eccentric, the points a', b', c', d', will be those described by the eccentric, while the slide takes the positions indicated by *a*, *b*, *c*, *d*.

But while the eccentric describes the arc $a'\ d'$, the crank of the axletree describes necessarily an equal angle. As that crank must be horizontal or coincide with *b*D at the end of the stroke of the piston, if from the point *p* we trace arcs equal to $d'\ c'$, $d'\ b'$ and $d'\ a'$, or in other words, arcs, the sines of which be, *dc*, *db* and *da*; and if we draw radii through the points thus determined, we shall evidently have in A′, B′, C′, and D′ the points where the crank was, while the eccentric passed through the points a', b', c' d'. Letting perpendiculars fall from the points A′, B′, C′, D′, on *b*D, we shall at last have in A, B, C, D, the corresponding situations which we sought for the piston.

Thus we recapitulate: while the slide passes from the point *a*, where it begins to intercept the steam, to the point *c*, where it opens the opposite passage, and to the point *d* end of the lead; the eccentric will run through the points a', c', d'; the crank, on its circle, will run through the points A′ C′ D′; and, finally, the piston will be successively at the point A, where it ceases to receive the impulse of the steam, at the point C, where it meets it opposing its motion, and at the point D, where it finishes its stroke.

Now, it will not be difficult to express by precise measure the spaces CD and AD, which we have represented above by a and ϵ.

For that purpose, it will be sufficient in practice to trace exactly, and by the scale, the fig. 27, and then to measure the resulting spaces CD, AD.

To obtain those same quantities by calculation, we have

$$AD = bD - bD \cos A'bD,$$

And, at the same time, expressing the arc A′*b*D by γ,

$$\operatorname{Sin} \gamma = \frac{ms}{bp} = \frac{ad}{bp}.$$

But *b*D is the half stroke of the piston, which we have expressed by l; and *bp* is the half range of the slide, which we shall express by l'. If, besides, we call a the lead of the slide or *cd*, and let r represent the lap of the slide over the apertures or *ab*, *ad* will be expressed by $a + 2r$. Thus the quantity sought AB or ϵ will be

$$\epsilon = \frac{l}{2} - \frac{l}{2} \cos \gamma,$$

The value of γ being given by the additional equation,

$$\operatorname{Sin} \gamma = \frac{a + 2r}{\frac{1}{2}\, l'} = \frac{2a + 4r}{l'}$$

In the same manner we shall have for CD, or a:

$$a = \frac{l}{2} - \frac{l}{2} \cos \gamma',$$

And γ will be known by the equation:

$$\operatorname{Sin} \gamma' = \frac{2a}{l'}.$$

The quantities a and ϵ, of which we have made use in the preceding paragraph, will, consequently be determined by the stroke of the piston, the range of the slide, the lead, and the lap, all of which are known quantities. Thus we will be enabled to calculate immediately the effect of the lead, either on the speed or on the load.

Having seen that the speed of the engine will be increased in the proportion of $\frac{l}{l - \epsilon}$, the consequence will be for the augmentation of the speed a ratio of

$$\frac{l}{l - \epsilon} = \frac{l}{\frac{l}{2} + \frac{l}{2} \cos \gamma} = \frac{2}{1 + \cos \gamma}.$$

In the same manner, the limit of the load

of the engine will be reduced as if the length of stroke of the piston was no more than $l - a - \mathcal{E}$, or

$$l - a - \mathcal{E} = \frac{l}{2}(\cos\gamma + \cos\gamma');$$

And in these two values, the arcs γ and γ' will be given by the above equations, viz.

$$\operatorname{Sin}\gamma = \frac{2a + 4r}{l'}, \text{ and } \operatorname{Sin}\gamma' = \frac{2a}{l'}.$$

The use of trigonometrical signs might be avoided in these formulæ; but it would make them less convenient for calculation.

In order to apply them, let us take, for example, an engine with a 16 in. stroke, range of the slide 3 in., lap of the slide over the apertures $\frac{1}{8}$ in., and let us suppose a lead of $\frac{5}{8}$ in. given to the engine.

In that case,

$$\frac{2a + 4r}{l'} = \frac{7}{12} = 0.58333.$$

The arc, the sine of whch is $\frac{2a + 4r}{l'}$, is consequently the arc, the sine of which is 0.58333; or, taking the logarithms, it is the arc, the logarithm sine of which is 9.76591.

Seeking that arc in the tables, we find that the logarithm of its cosine is 9.90967; and finishing the calculation, we find

$$\mathcal{E} = 8 \text{ in.} - 8 \text{ in.} \times 0.81222 = 1.50 \text{ in.}$$

In the same manner,

$$a = 8 \text{ in.} - 8 \text{ in.} \times 0.90906 = 0.73 \text{ in.}$$

Thus, we see that, in this case, the piston is at a distance of $1\frac{1}{2}$ in. from the bottom of the cylinder, at the moment the action of the moving power is taken away from it; and it is at $\frac{3}{4}$ in. when that same power is introduced against it. Fig. 27 constructed by the scale gives the same results.

From what has been said above, the speed will be augmented in the proportion of $\frac{l}{l - \mathcal{E}}$ or $\frac{16}{14.5}$, for all the loads that do not pass the limit of power of the engine thus regulated.

And the limit of that load will be reduced, as if the stroke, from the length that it had, be reduced to the length,

$$l - a - \mathcal{E} = 13.77 \text{ in.}$$

We find also, by supposing for the engine a lead of $\frac{1}{8}$ in., that the space that the piston has still to travel, when the steam is intercepted, is 0.25 in.; and that the steam is introduced in a contrary direction, when the piston is still within 0.03 in. from the bottom of the cylinder. From thence results that, with the above lead, the speed is augmented in the proportion of $\frac{16}{15.75}$, and that the *maximum* load is diminished, as if the length of the stroke was reduced to 15.72 in.

Let us take, for an example, an engine like VESTA, viz.

d, diameter of the cylinder $11\frac{1}{8}$ in., or 0.927 ft.; l, stroke of the piston, 16 in., or 1.33 ft.; D, diameter of the wheel, 60 in., or 5 ft.; F, friction of the engine, 187 lbs.

The limit of the load being given by the formula (Chap. V. Art. V. § 1),

$$M = \frac{(P - \rho)\, d^2\, l}{(\delta + n)\, D} - \frac{F}{\delta + n},$$

We see that if the engine work at the effective pressure of 56.5 lbs. per square inch, as we shall have an example of it in a moment, the limit of a load will be

In case of no lead at all	187 t.
In case of a lead of $\frac{1}{8}$ in.	183 t.
In case of a lead of $\frac{5}{8}$ in.	158 t.

In these same circumstances, according to the formula (Chap. V. Art. V. § 1), the velocity of the engine will be as follows:—

The lead of 187 t. will be drawn at a velocity of 13.81 miles an hour.

The load of 183 t., which, if there had been no lead, would have had a speed of 14.03 miles, will have an augmentation of speed in the proportion of $\frac{16}{15.75}$, that is to say, that the speed will be 14.25 miles an hour.

Finally, the speed of the load of 158 t., which, with no lead, would have been 15.54 miles, will, in consequence of the lead, become 17.14 miles per hour.

We see by these results, that the effect of the lead, either in regard to the speed or to the *maximum* load, are only very perceptible when the lead is rather considerable.

(To be Continued.)

APPENDIX.

EXPENSES OF HAULAGE BY LOCOMOTIVE ENGINES ON RAILWAYS.

We have said that, in order to complete the knowledge of locomotive engines, we have still to consider them as a matter of speculation; that is to say, to examine the amount of the expenses attending the haulage by means of locomotive engines on railways. That research is the object of the present Appendix.

We shall draw the documents we have to present on that subject from the two most flourishing undertakings of the kind in England: the Liverpool and Darlington Railways. They will have, besides, the advantage of presenting examples of two very different sorts of conveyance: the one very rapid, and principally composed of passengers; the other slow, and composed of goods.

The expenses attending more especially the haulage by means of locomotive engines, are limited to the keeping in repair of the engines, the maintenance of the way, and the consumption of fuel. There are some other expenses, also, but they do not give occasion to discussion, and it will be sufficient to find their amount stated in the specified reports we subjoin at the end of this Appendix.

§ 1. *Expense for repairs of Locomotive Engines.*

In the outlays above enumerated, the expenses which must naturally first of all draw our attention, are those which attend the keeping in repair of the engines.

Before we enter into any calculations on that head, it is necessary to mention that what is meant by repairs to the engines, is nothing less than their complete re-construction; that is to say, that when an engine requires any repair, unless it be for some trifling accident, it is taken to pieces, and a new one is constructed, which receives the same name as the first, and in the construction of which are made to serve all such parts of the old engine as are still capable of being used with advantage. The consequence of this is, that a re-constructed or repaired engine is literally a new one. The repairs amount thus to considerable sums, but they include also the renewal of the engines.

According to the tables at the end of this work, it will be seen that in the year ending on the 30th of June, 1834, the repairs of the engines of the Liverpool Railway cost:

From June 30, to December 31, 1833.

Materials for repairs - - -	£3,755 3 7	
Workmen - - -	4,401 4 10	
Repairs out of the establishment - - - -	613 3 9	
		£8,769 12 2

From December 31, 1833, to June 30, 1834.

Materials - - -	£4,140 19 6	
Workmen - -	5,432 8 8	
		9,573 8 2
		£18,343 0 4

The question is now what was the work executed by those engines during that interval? By consulting the specified statements which will be found below, we see that the goods conveyed on that line during the year have been:

Between Liverpool and Manchester (30 miles) - - -		139,328 t.
On part of the line, making an average of 15 miles,* 24,934 t., which, on the whole, is equal to - - - - - -		12,467
Sum - -		151,795 t.

In the tables we mentioned, we find some other haulage executed, such as that for Bolton and that of coals; but this work is executed by engines which do not belong to the company, and for that reason we do not take it into account in this place.

The above-mentioned weight is that of the goods conveyed, to which must be added the weight of the wagons. Now, on that railway, the average load of a wagon is 3.5 t., and the wagon itself weighs 1.5 t.; so the weight of the carriages that served for the above mentioned tonnage will be known by multiplying the number obtained, by the ratio $\frac{1.5}{3.5}$. And as, moreover, the engines, for want of sufficient returning traffic, are obliged to bring back half the wagons empty in one of the two directions, or $\frac{1}{4}$ of the whole, we shall have for the *gross weight* drawn by the engines in the course of the year—

Weight of the goods - - -	151,795 t.
Weight of the corresponding wagons - - -	65,055
Weight of the wagons brought back empty - -	16,264
	233,114 t.

This is the tonnage of the goods, to which must be added that of the travellers. In the course of the year, 415,747 travellers were conveyed from one city to the other in 6570 journeys.† This makes an average of 64

*The distance to which the company carries the Wigan and Warrington trade, which make the principal part of this article, is 15 miles.

† This is the number of the travellers inscribed in the company's books. It includes neither the travellers put down nor those taken up on the road, the numbers of which balance each other.

travellers pet train. The coaches required for that number of travellers, including the empty carriages added to each train to be ready for any emergency, are six carriages of the first class, or five of the second.*

The weight of six first class coaches, including the mail, is - -	21 t.
The weight of a second class train of five carriages, including one glass coach, is - - - -	12.6

Lastly, for 13 trains of the first class there are 16 of the second. Thus the average weight of the carriages for every 64 travellers may be reckoned at 16.4 t.

Consequently, the total weight corresponding to the travellers conveyed was:

415,747 travellers at 15 per t. -	27,717 t.
Corresponding weight of the carriages - - - -	107,748
Luggage of the travellers, at 28 lbs. each - - - -	5,197
	140,662 t.

Thus the total definite weight, drawn by the engines belonging to the company during the year was—

Gross weight for goods -	233,114 t.
Gross weight for travellers -	140,662
	373,776 t.

We have already shown in this work (Chap. IX. § 2) that, taking into account the surplus of resistance occasioned by the gravity at the passage of the inclined planes of that line, the load must be considered as carried to a distance of 34 miles and a half on a level. Thus as a ton carried to a distance of 34.5 miles is equal to 34.5 t. carried to a distance of one mile, the draft here above it equal to 12,895,272 gross tons carried to one mile on a level.

For that haulage the repairs of the engines cost £18,343 0s. 4d., consequently the repairs, per gross ton carried to one mile on a level, amounted to

0.342*d.*

In order to execute this haulage, the engines made 6570 journeys drawing stage-coaches, that is to say, with a velocity of 20 miles an hour; and 5086 journeys, with goods, or with a velocity of 12.5 miles an hour. The average velocity of the haulage, was consequently, in miles per hour, 16.73 miles.

We have said elsewhere that the Liverpool and Manchester Railway Company possesses at present thirty locomotive engines. It must not be concluded, however, that that number is necessary in order to execute the above said haulage. Of these 30 engines about one-third are useless. They are the most ancient which, having been constructed at the first establishment of the railway, at a time when the company had not yet obtained sufficient experience in that respect, are found now to be out of proportion with the work required of them.

The engines actually in daily activity on the road amount to about 10 or 11, and with an equal number in repair or in reserve the business might completely be ensured. This is in fact what happens at present, the surplus, above that number, being nearly abandoned.

We shall complete we have just been saying on the Liverpool locomotive engines, by adding a document that will show what these engines are capable of executing in a daily work, and the improvement they have undergone in the course of the last few years, in respect to the solidity of their construction.

WORK DONE BY THE TEN BEST ENGINES OF THE LIVERPOOL AND MANCHESTER RIALWAY, DURING THE YEARS 1831, 1832, 1833, AND THE TWELVE FIRST WEEKS OF 1834.

Year.	Name of the Engine.	Totaldistance travelled by the Engine.	Total time the engine has been on the road, either in activity or in repair.
		Miles.	Weeks.
1831.	MERCURY -	23,212	52
	JUPITER -	22,528	44
	PLANET - -	20,404	52
	SATURN -	19,510	38
	MARS - -	18,645	50
	MAJESTIC -	18,253	52
	NORTH STAR	15,677	52
	NORTHUMBR'N	15,607	52
	PHŒNIX -	15,405	52
	SUN - -	13,434	37
	Sum - -	182,675	481
	Av. per week	380	
1832.	VULCAN -	26,053	52
	LIVER - -	22,651	43
	VENUS - -	20,464	52
	ETNA - -	20,399	52
	SATURN -	20,312	52
	VESTA - -	17,739	52
	VICTORY -	17,082	52
	PLANET -	16,885	52
	SUN - -	16,535	52
	FURY - -	15,603	52
	Sum - -	193,723	511
	Av. per week	379	
1833.	JUPITER -	31,582	52
	AJAX - -	26,163	52
	FIREFLY -	24,879	39
	LIVER - -	23,134	52
	PLUTO - -	20,308	52
	VESTA - -	19,838	52
	LEEDS - -	19,364	48
	SATURN -	18,738	52
	VENUS - -	18,348	52
	ETNA - -	17,763	52
	Sum - -	220,117	503
	Av. per week	438	
1834.	FIREFLY -	8,542	12
	VULCAN -	8,526	12
	SATURN -	7,290	12
	LIVER - -	7,080	12
	SUN - -	7,080	12
	ETNA - -	6,557	12
	LEEDS - -	5,712	12
	AJAX - -	4,890	12
	VENUS - -	4,632	12
	PLUTO - -	4,246	12
	Sum - -	64,555	120
	Av. per week	538	

Among those engines, the *Liver* had worked for 107 weeks, had travelled 52,-865 miles, or, on an average 494 miles a-week during all that time; the *Firefly* had worked 57 weeks, had travelled a distance 33,421 miles, or 586 miles per week, and neither of these engines at the period in question, had yet required a fundamental repair.*

This statement shows what can be expected from locomotive engines, when constructed with care and of good materials; and there is no doubt that, in time, more work will still be obtained from them.

In order to give also an instance of the expense of repairs of locomotive engines, under other circumstances, and with another mode of construction of the engines, we shall set down here the work performed by the locomotive engines on the Darlington Railway. during the same year, that is to say, from June 30, 1833, to June 30, 1834, and the amount of expenses for repairing those engines for the same space of time.

On this Railway the number of trips of 20 miles, down hill, performed in the course of the year, was 5313¼. In each of these journeys the engine had to draw, in coals, a load of 63.6 t., which puts the total work at 6,764,951 t. carried to the distance of one mile.

But as this tonnage does not include the tare of wagons, and as, independently of this descending trade, it is also necessary to bring the empty wagons *up* the line again, this point requires our entering into some particulars, in order to be able to deduce from it the work really executed by the engines.

We shall elucidate it before we go any farther.

When a weight of one ton is drawn on a level Railway, we have seen that it requires a traction of 8 lbs. But if the line is not all on a level, upon each *ascending* plane, the gravity of the mass drawn will be an additional resistance to be overcome, and must consequently be added to the 8 lbs. traction, already necessary in order to overcome the friction of the wagons. For the contrary reason, in the *descending* planes that gravity enters into deduction of the power to be exerted, and must consequently be substracted instead of added.

If, however, the same train, after having ascended an inclined plane, descends another equal one, the addition in one case being exactly equal to the substraction in the other, the consequence will be, that the definitive resistance of a ton will remain the same as if the way had been level.

Or, if the way has a known average inclination, from which it deviates, at times augmenting and at others diminishing, returning, however, always to that average inclination, the same principle of compensation will stand good still, and it will be sufficient to calculate the traction required on that average inclination.

But this principle which has its foundation in the supposition that the engine is just as much eased in one point as it is overcharged in another, ceases to be true on all such planes where the gravity surpasses the friction; that is to say, on all planes where the inclination is greater than $\frac{1}{280}$. In fact, beyond that point the overcharging in ascending continues to augment rapidly, while the load in going down, already reduced to nothing on a plane at $\frac{1}{280}$, cannot diminish any more. All compensation therefore ceases.

This remark proves that the consideration of the gravity, on the average inclination of a line, gives the real resistance on that line, only in case it contains no des-

* The first class carriages are glass coaches, containing each 18 persons; they weigh 3.65 t. Those of the second class are open, and have 24 places; their weight is 2.23 t. Lastly, the mail-coaches weigh 2.71 t., and carry 10 travellers. Each glass coach has besides one outside place.

* The greater part of these excellent engines were built by R. Stephenson, so well known for his important and numerous improvements in this branch of industry.

The *Liver* engine, the merit of which is sufficiently established by the above stated facts, is the work of Messrs. Edward Bury and Kennedie, of Liverpool.

cending planes of a greater inclination than $\frac{1}{280}$, or in case those that are in that predicament have been reckoned separately.

Applying that principle to the Darlington Railway we find, according to the section of that line*, that on its total length there are eight inclined planes on which the gravity surpasses the friction. The length of these eight planes being together 10.23 miles, which is a half of the whole distance, we see that, during one half of their journey in descending, the Darlington engines have no traction to exercise, and that the trains go down of themselves. The remaining half of way, being practically level ($22\frac{1}{2}$ feet in descent for $10\frac{1}{2}$ miles,) the engines have on that part the traction of a level line, that is to say, 8 lbs. per ton. So their average traction during the whole descent is 4 lbs. per ton, or in other words, their work is equal to the draft of their load to half the distance on a level. We see here how great a mistake we would have made if we had taken as a rule the *average* inclination of the whole line; for that inclination being $\frac{1}{286}$, we would naturally have concluded that for all the descending trade, the traction was almost reduced to nothing.

Coming back, therefore, to the tonnage on the line, we have seen that it amounts, for the *goods*, to

6,764,951 t.

This number does not include the weight of the wagons themselves. These wagons weighing 1.30 t., and their load being 2.65 t., the addition to be made on that account, will be found in multiplying the above number by the ratio $\dfrac{1.30}{2.65}$.

Thus the total weight carried in *going down* the line is

Weight of the coals	6,764,951 t.
Weight of the wagon	3,318,656.
Total wt. drawn to a distance of one mile descending	10,083,607 gr. tons.

We have seen that the draft of one ton to the distance of one mile, in going down the line, is equal to the draft of the same load to the distance of half-a-mile *on a level.* The above-mentioned tonnage referred to a level, represents consequently 5,041,803 gross tons carried to a distance of a mile.

In order to estimate the draft in *going up*, we may retain or not the division of the line in two parts, the result is the same; but the simplest way is to make use of the average inclination at $\frac{1}{286}$. The calculation we have to make regarding only the *ascending* line, which contains no descending plane, and *a fortiori*, no descending plane of a greater inclination than $\frac{1}{286}$, the division established above is no longer necessary.

Considering, then, that the ascending trains are composed of 24 empty wagons, weighing together 31.2 t.; that, besides, on the inclined planes, the gravity of the engine and its tenders offers an additional resistance which would not take place on a level; finally, that the weight of the engine is 10 to 11 t., and that two of the tenders, half empty, 4.5 t.; which makes in all, on the inclined plane, a mass of 46.2 t., to be moved; it will be seen that the total resistance opposed by the steam, is,

Friction of the wagons, 31.2 t. at 8 lbs. per ton - - -	249.6 lbs.
Gravity of the mass 46.2 t. on an inclined plane at $\frac{1}{286}$	362
Total resistance,	611.6 lbs.

This, being the resistance that results from a train composed of 31.2 t. makes per ton 19.60 lbs., or in round numbers, 20 lbs. As we know, on the other hand, that on a level one ton requires only 8 lbs. traction, we see that the necessary force is here twice and a-half as great; or in other words, we see that the draft of one ton to a distance of one mile, *going up* that line, is equal to that of the same load to 2.5 miles *on a level.*

This granted, we have found that the haulage of the wagons is equal to 3,318,656 tons conveyed to the distance of one mile in going up. Referring this to a level, it will be represented by the same number multiplied by 2.6, that is to say, it will be 8,296.640 gr. t. carried to a distance of one mile on a level.

From which follows, finally, that the total work executed by these engines and referred to a level, is,

Draft in going down, in gross tons carried to a distance of one mile on a level . . .	5,041,803 t.
Draft in going up, measured in the same way	8,296,640
Sum . . .	13,338,443 t.

The number of tons of coals which produced this draft being, as we have seen, 6,764,951 t., we find that, on account of the weight of the necessary wagons and the difficulty of the draft in going up, the haulage of those six millions and a-half of *goods* produced really a draft equal to thirteen millions of tons on a level; that is to say, to be more accurate, that in comparing these two numbers, we see that the real work executed by the engines may be deduced from the weight of the goods by multiplying the latter number by 1.9718.

This first point established, we may now come to the amount of the expenses of repairs.

After having for a long while kept and repaired their engines themselves, the Directors of the Darlington Company decided, in order to avoid minute accounts, to enter into a contract for that; and, in consequence, in 1833, they put their engines in the hands of three persons.

By the contract entered into, and which is at present in force, the company pays $\frac{4}{10}$ of a penny per ton of *goods*, carried to a distance of one mile; and, for that price, the contractors have undertaken, not only to keep the engines in good repair, furnishing workmen and materials, but also to pay all the current expenses of haulage, such as salary of the engine men, fuel, oil, grease, &c. Besides this, they must also pay the company an interest of five per cent. on the capital representing the value of the engines, and of all the establishments placed at their disposal for working.

The total sum paid to the contractors by the company for that object during the year ending June 30, 1834, was

£11,347 1*s.* 9*d.*

And deducting the expenses for rent, interest of capital and haulage, the amount of which is known, the directors of the company reckon that the definitive sum remaining with the contractors for the repairs of the engines (bars of the fire-box included,) amount, with the general profit on the whole undertaking, to

£5,732 18*s.* 5*d.*

This sum has been expended for the carriage of 13,338,443 gross tons to a distance of one mile on a level; so that finally the expense, per gross ton carried to one mile on a level, including the profits on the undertaking amont to

0.103*d.*

As a complement to what we have said, and to show on this railway as well as upon the Liverpool one, the work the engines are able to perform, we shall give a table of the haulage executed, and repairs undergone by the engines during the last five last months of the year 1833.

* The part of that Railway travelled by the locomotive engines begins at the foot of Brusselton inclined plane, at an elevation of 383 ft. 1 in. above the quay at Stockton, where it terminates, after passing over the following inclinations:

Miles.			
0.46	- -	descent.	at $\frac{1}{311}$
0.06	- -	do.	- $\frac{1}{325}$
0 92	- -	do.	- $\frac{1}{144}$
1.45	- -	do.	- $\frac{1}{121}$
2.25	- -	do.	- $\frac{1}{528}$
1.25	- -	do.	- $\frac{1}{135}$
1.01	- -	do.	- $\frac{1}{352}$
1.76	- -	do.	- $\frac{1}{133}$
0.20	- -	do.	- $\frac{1}{396}$
1.75	- -	do.	- $\frac{1}{1584}$
1.61	- -	do.	- $\frac{1}{1468}$
1.64	- -	do.	- $\frac{1}{204}$
0.23	- -	do.	- $\frac{1}{713}$
2.09	- -	do.	- $\frac{1}{2192}$
1.25	- -	do.	- $\frac{1}{253}$
0.03	-	level.	-
0.81	- -	descent.	- $\frac{1}{226}$
0.05	- -	do.	- $\frac{1}{487}$
0.80	- -	do.	- $\frac{1}{1584}$
1.16	- -	do.	- $\frac{1}{104}$

Sum 20.78. Average inclination, 383 feet on 109,692 feet, or $\frac{1}{286}$.

Besides the principal line, there are lateral branches over which the locomotive engines also travel, but the level of which has not been taken. The aggregate space travelled over by the locomotive engines is 24 miles. The rest of the Railway consisting of 16 miles more, is worked by horses and by stationary steam-engines.

STATEMENT OF THE WORK DONE BY THE LOCOMOTIVE ENGINES ON THE DARLINGTON RAILWAY, FROM JULY 1, TO DECEMBER 1, 1833.

Number of the engine.	Name of the engine.	Total number of miles travelled by the engine.	Tons of coals carried to one mile going down by the engine.	Gross tons carried to one mile on a level including the wagons and return.	Number of days that the engine was: In activity.	In repair.	Amount of the repairs made to the engine during that time.	Amount of the repairs per gross ton carried to 1 mile on a level.	Observations.
		miles.	tons.	tons.	days.	days.	£ s. d.	d.	
1	Locomotion	5,300	146,041	287,896	80	52	41 19 7	0.085	Boiler with a flue and two returning tubes.
2	Hope	3,100	82,305	162,281	66	69	57 5 5	0.085	" with a single flue.
3	Black Diamond	1,000	26,920	53,078	27	105	14 0 5	0.063	" with a single flue.
4	Diligence	80	1,906	3,758	2	130	13 18 3	0.889	Engine taken to pieces.
5	Royal George	700	23,733	46,794	11	121	161 7 8	0.828	Boiler with a flue and one returning tube.
6	Experiment	4,400	122,442	241,420	70	62	53 1 2	0.053	ditto
7	Rocket	3,940	109,512	215,925	64	68	57 0 9	0.063	ditto
8	Victory	10,600	349,150	688,418	107	25	58 3 10	0.020	ditto
9	Globe	3,120	70,682	139,365	60	72	36 4 6	0.062	Boiler with 120 returning tubes.
10	Planet	1,200	20,429	40,280	27	105	53 7 5	0.318	" with 88 "
11	North Star	2,400	47,546	93,746	55	77	32 5 10	0.083	" with 88 "
12	Majestic	2,880	90,422	178,282	47	85	131 2 3	0.177	" with 104 "
13	Coronation	2,940	97,687	192,609	52	80	46 16 2	0.058	" with 104 "
14	William IV.	4,060	134,540	265,075	55	77	78 19 8	0.072	" with 104 "
15	Northumbrian	4,480	143,885	283,698	59	73	67 14 11	0.057	" with 104 "
16	Director	5,860	202,492	399,253	91	41	107 19 11	0.065	Boiler with tubes on the model of Napier's patent.
17	Lord Brougham	4,780	155,729	307,051	62	70	62 5 10	0.049	Boiler with 104 returning tubes.
18	Shildon	4,720	159,400	314,289	63	22	49 16 3	0.038	" with a flue and two returning tubes.
19	Darlington	6,180	200,110	394,559	88	44	45 0 6	0.027	" with a flue and two returning tubes.
20	Adelaide	3,700	126,390	249,202	71	61	90 11 7	0.087	" with 104 returning tubes.
21	Earl Grey	7,960	276,462	545,088	110	22	14 19 6	0.007	" with a flue and two returning tubes.
22	Lord Durham	6,480	213,737	421,424	84	48	67 13 8	0.039	" with 104 returning tubes.
23	Wilberforce	4,200	141,534	279,062	55	9	51 17 11	0.045	" with 104 "
	Sums	94,080	2,942,925	5,802,562	1403	1518	1393 13 0	0.058	

The greatest part of the machines were constructed by Mr. Timothy Hackworth, of Shildon, near Darlington, and bear testimony to his skill. Twelve of them were almost new at the time this statement was made.

§ 2. *Expense for Maintenance of Way.*

The expenses for keeping the Liverpool Railway in repair, during the year we are considering, are given in the reports that will be found below. From the sums put down must be deducted the articles *ballast* and *new rails*, the first being caused by the recent construction of the road, that is to say, by the gradual sinking of the embankments, which are not completely compact, and the second being an extraordinary replacing of the rails on a part of the line.

Putting, therefore, those two articles aside, the expenses for repairing the railway, during the year ending on the 1st of June, 1834, were

£11,053 2s. 6d.

During the same time, the loads that passed on the railway drawn either by the company's engines, or by engines belonging to other companies, were

Goods on the whole road 139,328 t.
—— on the half of the road 24,934 t., making on the whole line . . 12,467
—— between Bolton and Manchester or Liverpool 38,341 t., or on the whole road . . 19,170
Coals on the half of the line 86,173, or on the whole . . 43,086

214,051 t.

Correspoding wagons ($\frac{1.5}{3.5}$ of the weight of the goods) . . 128,431
Wagons brought back empty (¼ of the whole) . . 32,108
Carriages, and passengers' luggage, as above . . 140,662

Sum . . 515,252 t.

Thus 515,252 gr. t. passed on each mile of the railway, having amounted to £11,053 2s. 6d., or to £368 8s. 1d. per mile, the expense per mile for each ton carried was

0.171*d.*

In this calculation we have only taken the *useful* length of the railway; that is to say, that we have omitted the sidings, &c., they being only the necessary complement of the principal line.

On the Darlington line, during the same year, the expenses for repairs on the 24 miles run over by the locomotive engines, were

Workmen . . £4,253 0 0
Materials . . 2,060 0 0

£6,313 0 0*

The weight that passed during the same time, on that part of the railway, was:

Coals, 6,764,951 tons carried to distance of one mile, or upon the whole of the 24 miles 281,873 t.
Corresponding wagons ($\frac{1.30}{2.65}$ of the weight of the goods) 138,277
Wagons going up the line (same weight) 138,277

558,427 t.†

The expenses for the whole of these 24 miles amounting to £263 0s. 10d. Thu the expenses for maintenance of way, per mile, and for each gross ton conveyed on the road, were

0.113*d.*

We have here also, as well as above, left out the crossings, sidings, &c.

* The total expense for repairs of the line, during the year we are considering, were

Workmen { For the 24 miles run over by the locomotive engines . . £4,253 0 0
For the 16 miles worked by horses or stationary engines 1,067 5 0 }
Materials for repairs { Space run over by the locomotive engines . . 2,060 0 0
Parts worked by horses or stationaryengines 518 3 8 }
Repairs to bridges . . 69 17 7
Repairs to walls and fences . 280 7 11
Accidental expenses . . 467 3 7

Total expenses . £8,715 17 9

N. B. The distinction between the expenses relating to the space run over by locomotive engines and by horses, could only be made by approximation; as the company does not keep separate accounts in that respect.

† Besides this weight, there passes on the line a small number of stage coaches, which for the last few months have been drawn by locomotive engines. But this haulage being inconsiderable, we did not wish to embarrass our calculation with it

This amount would undoubtedly be diminished if the Darlington wagons were on springs, like those of the Liverpool Railway.

These expenses, as we have seen, amount only to the two-thirds of those of the Liverpool Railway for the same object. The difference is owing to the rapid motion of the engines and carriages that pass on the latter railway. But it is chiefly in the expense for repairs of engines that this effect of velocity is felt.

It must not, however, be supposed that the considerable difference observed in that respect, between the engines of the two companies, is exclusively owing to the velocity of the motion. That velocity enters, indeed, for a great part in it, but the conditions attending each sort of business have a no less considerable influence on it. What we mean is, that passengers forming the chief business on the Liverpool line, their safety requires that a much greater care be taken of the engines than when the load is composed only of coals, as on the Darlington Railway. The consequence is, that the Liverpool engines are kept with a degree of care, we might even say of luxury, to which the Darlington ones can by no means be compared. In order to explain completely our idea, we shall say that the business of the Darlington Railway is a business of wagonage, and that of the Liverpool Railway a business of stage coaches.

(To be Continued.)

TO CONTRACTORS.

PROPOSALS will be received at the Office of the Eastern Railroad Company, Boston, between the 28th and 30th inst., for the grading and masonry of said Road from East Boston to Newburyport, a distance of 33½ miles

The line of this road is along a favorable country, passing through Lynn, Salem, Beverly, and Ipswich, which places will afford contractors every facility for obtaining provisions, &c. Plans and Profiles will be ready, and may be seen at the Office, after the 22d instant.

Satisfactory recommendations must accompany the proposals of those who are unknown to the Engineer.

22—t30j JOHN M. FESSENDEN, Engineer.

☞ THE NEWCASTLE MANUFACTURING COMPANY, incorporated by the State of Delaware, with a capital of 200,000 dollars, are prepared to execute in the first style and on liberal terms, at their extensive Finishing Shops and Foundries for Brass and Iron, situated in the town of Newcastle, Delaware, all orders for LOCOMOTIVE and other Steam Engines, and for CASTINGS of every description in Brass or Iron RAILROAD WORK of all kinds finished in the best manner, and at the shortest notice.

Orders to be addressed to

MR. EDWARD A. G. YOUNG,
Superintendent, Newcastle, Delaware.

feb.20—ytf

NOTICE OF THE NEW-YORK AND ERIE RAILROAD COMPANY.

THE Company hereby withdraw their Advertisement of 26th April, in consequence of their inability to prepare in time, the portions of the line proposed to be let on the 30th June, at Binghampton, and on the 11th of July at Monticello. Future notice shall be given, when proposals will be received at the above places, for the same portions of the road.

21—tf JAMES G. KING, President.

AMES' CELEBRATED SHOVELS, SPADES, &c.

300 dozens Ames' superior back-strap Shovels
150 do do do plain do
150 do do do cast steel Shovels & Spades
150 do do Gold-mining Shovels
100 do do plated Spades
50 do do socket Shovels and Spades.

Together with Pick Axes, Churn Drills, and Crow Bars (steel pointed,) manufactured from Salisbury refined iron—for sale by the manufacturing agents,

WITHERELL, AMES & CO.
No. 2 Liberty street, New-York.
BACKUS, AMES & CO.
No. 8 State street, Albany

N. B.—Also furnished to order, Shapes of every description, made from Salisbury refined Iron. 4—ytf

FRAME BRIDGES.

THE subscriber would respectfully inform the public, and particularly Railroad and Bridge Corporations that he will build Frame Bridges, or vend the right to others to build, on Col. Long's Patent, throughout the United States, with few exceptions. The following sub-Agents have been engaged by the undersigned who will also attend to this business, viz.

Horace Childs,	Henniker, N. H.
Alexander McArthur,	Mount Morris, N. Y.
John Mahan,	do do
Thomas H. Cushing,	Dover, N. H.
Ira Blake,	Wakefield, N. H.
Amos Whitmore, Esq.,	Hancock, N. H.
Samuel Herrick,	Springfield, Vermont.
Simeon Herrick,	do do
Capt. Isaac Damon,	Northampton, Mass.
Lyman Kingsly,	do do
Elijah Halbert,	Waterloo, N. Y.
Joseph Hebard,	Dunkirk, N. Y.
Col. Sherman Peck,	Hudson, Ohio.
Andrew E. Turnbull,	Lower Sandusky, Ohio.
William J. Turnbull,	do do
Sabried Dodge, Esq.,	(Civil Engineer,) Ohio.
Booz M. Atherton, Esq.	New-Philadelphia, Ohio.
Stephen Daniels,	Marietta, Ohio
John Rodgers,	Louisville, Kentucky.
John Tillson,	St. Francisville, Lous'a.
Capt. John Bottom,	Tonawanda, Penn.
Nehemiah Osborn,	Rochester, N. Y.

Bridges on the above plan are to be seen at the following localities, viz. On the main road leading from Baltimore to Washington, two miles from the former place. Across the Metawamkeag river on the Military road, in Maine. On the National road in Illinois, at sundry points. On the Baltimore and Susquehanna Rrailroad at three points. On the Hudson and Patterson Railroad, in two places. On the Boston and Worcester Railroad, at several points. On the Boston and Providence Railroad, at sundry points. Across the Contocook river at Hancock, N. H. Across the Connecticut river at Haverhill, N. H. Across the Contoocook river, at Henniker, N. H. Across the Souhegan river, at Milford, N. H. Across the Kennebec river, at Waterville, in the state of Maine.—Across the Genesse river, at Mount Morris, New-York, and several other bridges are now in progress.

The undersigned is about to fix his residence in Rochester, Monroe country, New-York, where he will promptly attend to orders in this line of business to any practicable extent in the United States, Maryland excepted.

MOSES LONG.
General Agent of Col. S. H Long.

Rochester, May 22d, 1836. 19y-tf.

PATENT RAILROAD, SHIP AND BOAT SPIKES.

☞ The Troy Iron and Nail Factory keeps constantly for sale a very extensive assortment of Wrought Spikes and Nails, from 3 to 10 inches, manufactured by the subscriber's Patent Machinery, which after five years successful operation, and now almost universal use in the United States, (as well as England, where the subscriber obtained a patent,) are found superior to any ever offered in market.

Railroad Companies may be supplied with Spikes having countersink heads suitable to the holes in iron rails, to any amount and on short notice. Almost all the Railroads now in progress in the United States are fastened with Spikes made at the above named factory—for which purpose they are found invaluable, as their adhesion is more than double any common spikes made by the hammer.

*** All orders directed to the Agent, Troy, N. Y., will be punctually attended to.

HENRY BURDEN, Agent.

Troy, N. Y., July, 1831.

*** Spikes are kept for sale, at factory prices, by I. & J. Townsend, Albany, and the principal Iron Merchants in Albany and Troy; J. I. Brower, 222 Water street, New-York; A. M. Jones, Philadelphia; T. Janviers, Baltimore; Degrand & Smith, Boston.

P. S.—Railroad Companies would do well to forward their orders as early as practicable, as the subscriber is desirous of extending the manufacturing so as to keep pace with the daily increasing demand for his Spikes.

1J23am H. BURDEN.

ARCHIMEDES WORKS.

(100 North Moor street, N. Y.)

NEW-YORK, February 12th, 1836.

THE undersigned begs leave to inform the proprietors of Railroads that they are prepared to furnish all kinds of Machinery for Railroads, Locomotive Engines of any size, Car Wheels, such as are now in successful operation on the Camden and Amboy Railroad none of which have failed—Castings of all kinds, Wheels, Axles, and Boxes, furnished at shortest notice.

4—ytf H. R. DUNHAM & CO.

NOTICE TO CONTRACTORS.

JAMES RIVER AND KANAWHA CANAL.

PROPOSALS will be received at the Office of the James River and Kanawha Company, in the City of Richmond, from the 15th to the 23rd day of August, for the construction of all the Excavation, Embankment and Walling not now under contract, together with nearly all the Culverts and the greater portion of the Locks between Lynchburg and Maidens' Adventure.

The work now advertised embraces the twenty miles between Columbia and the head of Maidens' Adventure Pond, the eight miles between Seven Island Falls and Scottsville, and about twenty isolated sections, reserved at the former letting, between Scottsville and Lynchburg.

The quantity of masonry offered is very great—consisting of about two hundred Culverts of from three to thirty feet span; nine Aqueducts, thirty-five Locks a number of Wastes, with several farm and road Bridges.

General plans and specifications of all the work, and special plans of the most important Culverts and Aqueducts, will be found at the offices of the several Principal Assistant Engineers on the line of the Canal.

The work will be prepared for examination by the 25th July; but mechanics, well recommended, desirous of immediate employment, can obtain contracts for the construction of a number of Culverts at private letting.

Persons offering to contract, who are unknown to the subscriber, or any of the Assistant Engineers, will be expected to accompany their proposals by the usual certificates of character and ability.

CHARLES ELLET, Jr.,
Chief Engineer of the James River and Kanawha Company.

NOTE.—The Dams, Guard-Locks, most of the Bridges, and a number of Locks and Culverts, are reserved for a future letting. Persons visiting the line for the purpose of obtaining work, would do well to call at the office of the Company in the city of Richmond, where any information which they may desire will be cheerfully communicated.

The valley of James River, between Lynchburg and Richmond, is healthy. (20—ta18) C. E. Jr.

RAILROAD CAR WHEELS AND BOXES, AND OTHER RAILROAD CASTINGS.

Also, AXLES furnished and fitted to wheels complete at the Jefferson Cotton and Wool Machine Factory and Foundry, Paterson, N. J. All orders addressed to the subscribers at Paterson, or 60 Wall street, New-York, will be promptly attended to.

Also, CAR SPRINGS.

Also, Flange Tires, turned complete.

J8 ROGERS, KETCHUM & GROSVENOR.

ALBANY EAGLE AIR FURNACE AND MACHINE SHOP.

WILLIAM V. MANY manufactures to order, IRON CASTINGS for Gearing Mills and Factories of every description.

ALSO—Steam Engines and Railroad Castings of every description.

The collection of Patterns for Machinery, is not equalled in the United States. 9—1y

RAILWAY IRON.

95 tons of 1 inch by ⅜ inch.
200 do 1¼ do ⅜ do
40 do 1½ do ⅜ do
800 do 2 do ½ do
800 do 2¼ do ⅝ do
soon expected.

FLAT BARS in lengths of 14 to 15 feet, counter sunk holes, ends cut at an angle of 45 degrees, with splicing plates and nails to suit.

250 do. of Edge Rails of 36 lbs. per yard, with the requisite chairs, keys, and pins.

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